Founded as Metal Industry, January, 1903
by Palmer H. Langdon, 1868-1935

Published Monthly by

FINISHING PUBLICATIONS, INC.

Serving the electroplating and industrial coating fields with specialized monthlies and guidebooks since 1903. Companion publication, ORGANIC FINISHING.

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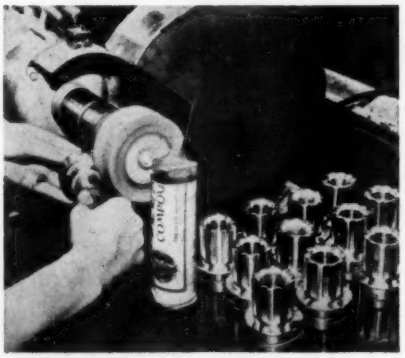

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TABLISHED 1903
D EXCLUSIVELY TO METALLIC SURFACE TREATMENTS
METAL FINISHING
LUME 52 • NUMBER 7 • JULY, 1954

Finishing Specifications

In this issue appears an interesting article by William Phillips on the history and development of plating in the automotive industry, in which the reader is introduced to the origin of plating specifications. It will be noted that specifications were not just picked out of a hat but arrived at their present status through the slow process of evolution.

Too often, unfortunately for the plater, this fact has not received the recognition which its importance warrants. As a result, he has been regularly confronted with specifications prepared without consideration of practical requirements and by persons lacking the background of experience essential for this difficult engineering detail. This has led to ridiculous thickness and salt spray requirements, completely inconsistent with desired corrosion resistance or intended service of the part in question. Many will be reminded of the old requirement of 0.0005″ thickness of cadmium on articles which were to be employed indoors and we could submit many more instances to corroborate this observation.

Our comments are directed not only to those who specify finishes but also to those who have to meet them. Not only must a specification be reasonable and capable of fulfillment, it should leave no opportunity for misunderstanding, since ambiguity can only lead to controversy. Before the finisher accepts a job, he should make sure that the requirements are clear. If salt spray resistance is required, in what position should the part be exposed, how many samples are to be tested from each lot, and how many corrosion spots will be tolerated without rejection? If plating is to be of specified minimum thickness, the number of samples per lot to be tested, the significant surface where the thickness is to be determined, and the allowable percentage of underplated samples should all be included.

Obviously, this meeting of minds can more readily be assured if the finisher is consulted *before* specifications are drawn up. The alternative is possible disagreement and, too often, unnecessary expenditures of time and money.

Nathaniel Hall

The Structure of Electrodeposits

By J. J. Dale

***Editors' Note*—The author graduated in Metallurgical Engineering at the Melbourne University and is at present with the Defense Standards Laboratories at Maribyrnong, Victoria. This article is based on a paper delivered to The Australian Institute of Metals and which was intended to partially satisfy the natural curiosity of metallurgists as to the structure of metals formed by electroplating. As the subject is also of considerable interest to electroplating technologists it is presented here in a slightly revised form.**

Introduction

WHILE the chief use of electrodeposits has always been as thin coatings for corrosion protection, they are nowadays finding increasing application as much thicker coats.

Their employment in engineering for the building up of and even for the fabrication of metal articles has reached such a stage that electrodeposition takes its place alongside casting, rolling, forging, stamping, and the like, as a recognized method of manufacture. Of these older established processes, it bears greatest resemblance to casting, and the building up of thick deposits for engineering purposes has been very aptly termed "cold casting." This term refers especially to the ease with which complex shapes may be formed or covered with a metal coating of any desired thickness without any of the disadvantages attendant upon the high temperatures met with in casting. The similarity of the process to casting applies not only to the method and the shapes obtainable, but also the structure, and it will be shown that many of the structural features of electrodeposits have their counterparts in cast structures.

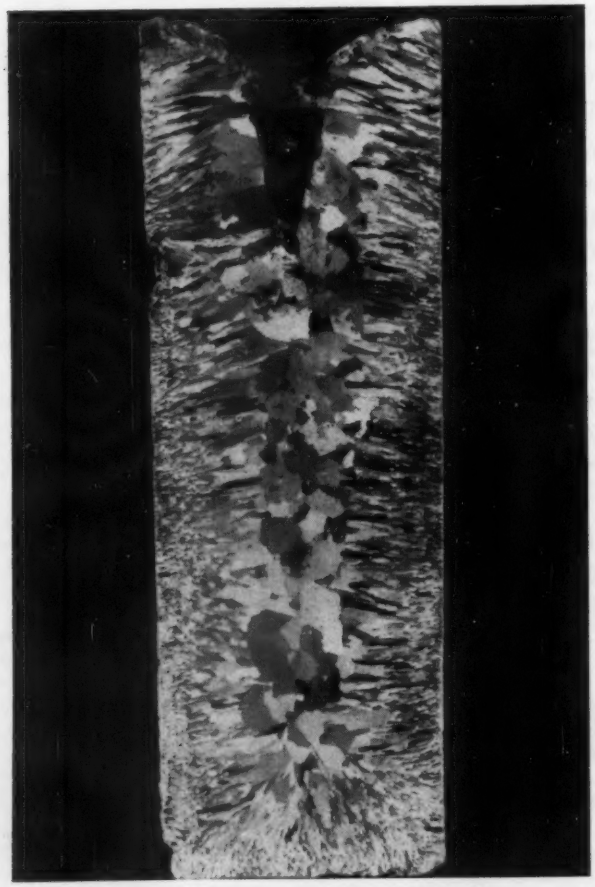


Figure 1. Structure of Cast Metal X1.

Figure 2. Structure of Wrought Metal X250.

A knowledge of the structure of the metal employed in fabricating an article is important in gauging the extent to which measured mechanical properties can safely be used to predict behavior in service. The designer and metallurgist must be familiar with the nature and effects of the possible defects and abnormalities which can be present in a material proposed for use in a certain application.

The present state of knowledge of the structure of electrodeposits is based on the researches and observations of a large number of investigators and is covered by hundreds of references in the technical press. Over the past 30 years there have been two main "schools" of research in electroplating, namely, the Bureau of Standards in U.S.A. and the Woolwich Arsenal group in England; these have both done their share of work on structure. A great impetus to the study of the subject

was given by the Faraday Society in 1935 when it held a symposium on "The Structure of Metallic Films and Surfaces" to which most of the leading investigators of the time contributed. Among individual contributors Cymboliste of France is worthy of special mention. He has published well over a hundred photomicrographs, many of which deal with abnormalities and defects in electrodeposits.

Among the more recent reviews of the subject is the one in the Electrochemical Society's Special Volume "Modern Electroplating"[1] and useful papers by Hothersall[2] and Finch and Layton[3]. In addition considerable recent work has been done in various universities on X-ray and electron diffraction studies of electrodeposits. The present paper does not go into much detail on this work but tends more to regard deposits from the viewpoint of that old standby of the practical metallurgist, the microstructure. The numerous illustrations which accompany this paper show types of structure met with. While most come from the author's collection, a number are taken from various articles listed at the end of this paper.

Metal Structures

All solid metals, including electrodeposits are fundamentally crystalline. Crystals are built up from the basic atomic lattices peculiar to each metal. (Investigation of lattice structure lies in the realm of X-ray and electron diffraction.) These crystals are aligned and joined together in various ways to give the various characteristic shapes and patterns which can be observed visually and are commonly referred to as the "structure". The term "grain" is often used to mean a crystal. Strictly speaking it also denotes a collection of similarly aligned crystals which resemble a single crystal. The grain patterns are often too fine to be observed without a microscope and hence the term "microstructure" is also used to describe them. The structure is usually revealed by polishing and etching a section of the specimen in question. Etching causes differently aligned grains to reflect light to different extents and also preferentially attacks and so reveals grain boundaries. Most of the illustrations in this paper are photographs of polished and etched microsections.

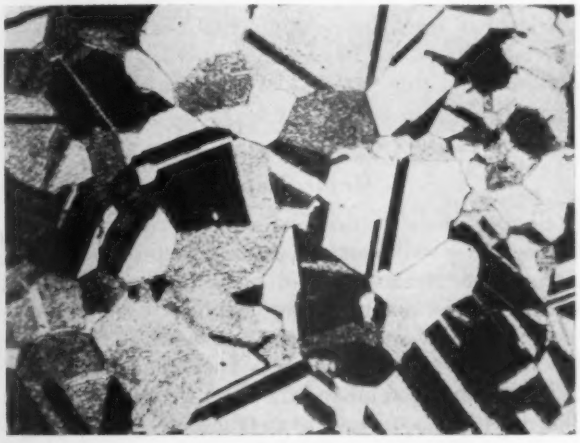


Figure 3. Structure of Annealed Metal X250.

A wide variety of patterns occurs due to variations in three major factors namely size, shape and orientation of the grains. Most of these variations can be traced back in various ways to the origin of the metal and its subsequent treatment.

Figure 4. Acid Copper Deposit X250 Bath Temperature 50°C.

Figures 1, 2 & 3 are included for the sake of interest and show the typical structures of a non-electrolytic metal, (70/30 Brass), in its three commonest forms. The cast metal is characterized by growth of columner grains perpendicular to the mold surface. The wrought metal has grains elongated in the direction of working, while the annealed metal has equiaxial grains which are frequently twinned as in Fig. 3.

The grain size of different deposits varies enormously, the complete quoted range being from about 50 Å up to those visible to the naked eye[1]. The major variations occur between deposits produced from baths of a fundamentally different nature. Variations in grain size between deposits produced from the same bath are on a lesser scale and are controlled by plating conditions in a manner to be described later.

In the meantime, it will be helpful to consider the various types of structure met with electrodeposits and how they can be classified.

Structural Features of Electrodeposits

The basic mode of formation of an electrodeposit, by which crystals grow out from a surface, gives rise to the most typical habit of metals in this form which may broadly be classified as a columnar structure. As might be expected, most deposits show preferred orientation when examined by X-ray diffraction. This general columnar structure is roughly similar in alignment and origin to the dendritic structure found in a casting.

Figures 4 and 5 show typical columnar structures in copper and nickel deposits respectively. This general type of structure may also occur in forms varying somewhat from the typical; for example, acicular. That is, needle like structures are seen as in the brass deposit shown in Figure 6, while acicular crystals may combine to give a structure like that in Figure 7, also of a brass deposit. Again, crystals are often seen radiating from some point, as in Figure 8, which shows a nickel deposit. Figure 5 shows the same thing to a lesser extent, and also shows how the initial growth is perpendicular to the basis metal even over small changes in contour. Intersections of such radiating

fan-like systems can cause a plane of weakness (Figure 9), or even a cavity (Figure 10) in a deposit[4].

Other less common, though no less typical, structures observed include nodular or spheroidal structures (Figure 11) and laminated or banded deposits.

The banded structure is a characteristic of deposits produced by P.R. plating although it is also frequently obtained when there are no current reversals or interruptions.

Figures 12[5] and 13 illustrate the possibility of getting two or more of these types superimposed. Figure 13 shows a banded nodule with an acicular fan-like background in a thick brass deposit. Some deposits, particularly when current interruptions occur during production, contain so many structures and are so complex that they almost defy classification. The examples shown in Figures 14 and 15, still of brass deposits, are in this class.

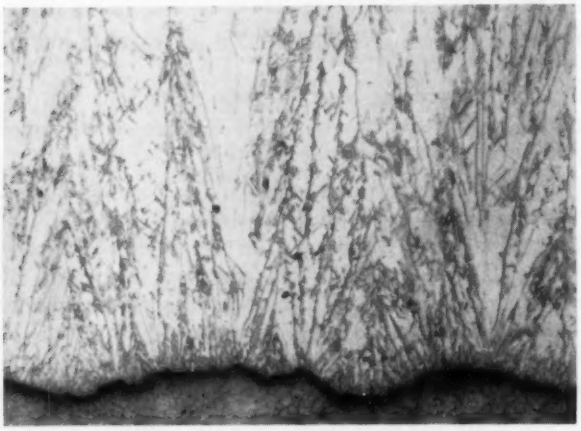


Figure 5. Nickel Deposit X100.

Figure 6. Brass Deposit X250.

Figure 7. Brass Deposit X500.

Figure 8. Nickel Deposit X100.

Major Defects

Some of the structural features so far described may be seen in good commercial heavy deposits and may perhaps be characteristic of a certain type of plating bath. The best plating conditions, however, are not always obtained, and the desired smooth, uniform, continuous and adherent coatings may not be produced. When plating conditions are not properly controlled, the deposit may grow in an abnormal manner, and certain malformations and defects will occur. Such defects as large nodules, trees, pits, blisters and cracks may be produced. These defects will be considered in more detail later.

The following list classifies various structural features which have been mentioned above.

COMMON FORMS
- Columnar Structure
  - Acicular Crystals
  - Conical Crystals
  - Fan-like Groups

LESS COMMON FORMS
- Nodular or spheroidal Shapes
- Laminated or Banded Deposits

DEFCTS AND ABNORMALITIES
- Large nodules
- Trees
- Pits
- Blisters
- Cracks
- Burnt deposits
- Powdery deposits

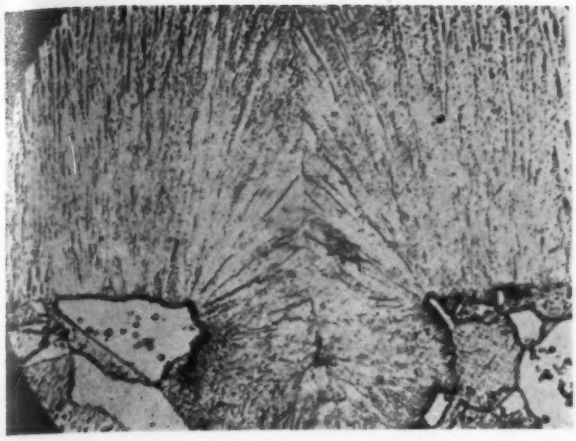


Figure 9. Nickel Deposit [4] X300.

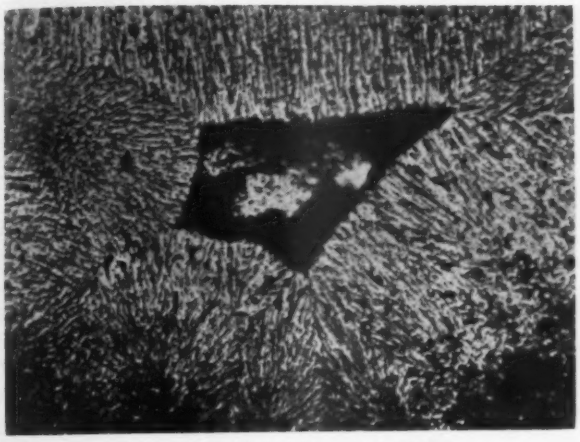


Figure 10. Nickel Deposit [4] X1000.

Growth of Deposits

The actual happenings in the formation of electrodeposits are not easy to describe simply, because many factors are operating and many different phenomena may occur. Readers who are especially interested are advised to refer to recent reviews by Hothersall[2] and by Finch and Layton[3]. These two papers are quite different in their approach so that together they give a wide coverage of the subject.

At the very beginning of an electrodeposition process a continuous metal film is *not* formed on a cathode surface. The growth of a film is initiated at various points or nuclei on the surface and from these points crystals grow fairly rapidly sideways, as well as slowly outwards, until the stage is reached, perhaps within a few seconds, when the crystal boundaries meet to form a continuous film. There is as yet no generally accepted view as to which particular points or features of a cathode surface will act as nuclei. Surface irregularities, scratches, pits and other imperfections have been observed to have a profound effect on the location of nuclei[4]. It would seem natural for the high points on a surface to act as nuclei since these points receive a higher proportion of the current, and indeed many published photomicrographs, as for example Figure 9, show that such high points act as centers of growth of radiating structures. Very recently, however Steer[6] has shown by means of advanced metallographic techniques, that nickel deposition may commence in the depressions on a polished and then lightly etched cathode surface. He points out that as such points are furthest from the disturbed layer on the surface, they are the points of least free energy.

The conflict between these two views may only be apparent, as the different mechanisms might well occur in different circumstances and probably both will later be fitted into a satisfactory theory.

Consideration of crystal growth from nuclei recalls the classical theories advanced in discussing crystallization of a metal from the liquid state, and one finds the basic concepts propounded by Tamman quoted in papers on structure of electrodeposits.[7] He pictured the following two opposing tendencies, the relative magni-

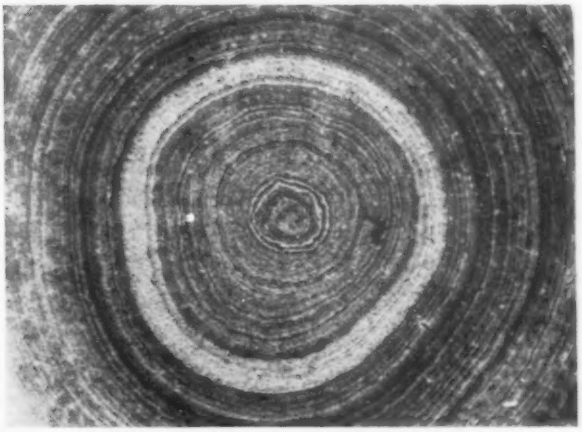


Figure 11. Nodular Cobalt Deposit X100.

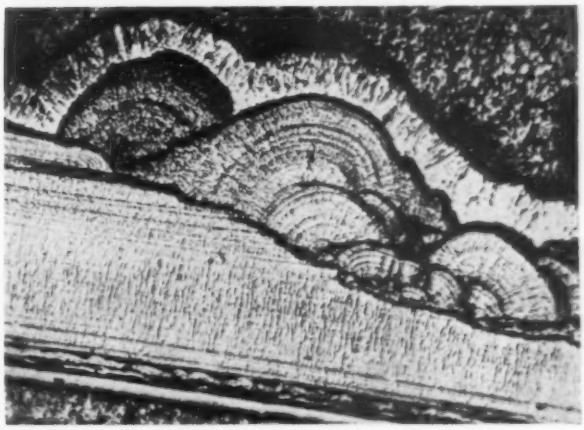


Figure 12. Lead-Copper Alloy Deposit [5] X500.

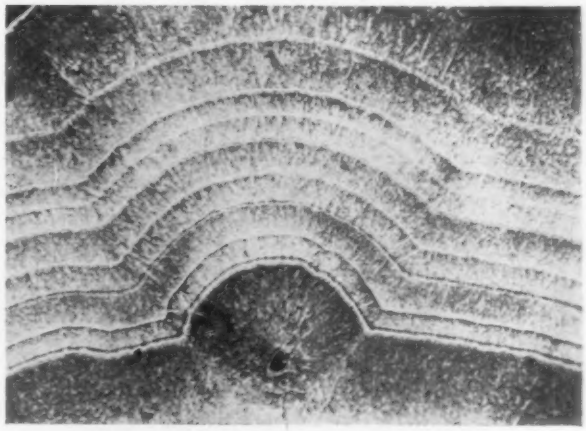


Figure 13. Nodule in Brass Deposit X100.

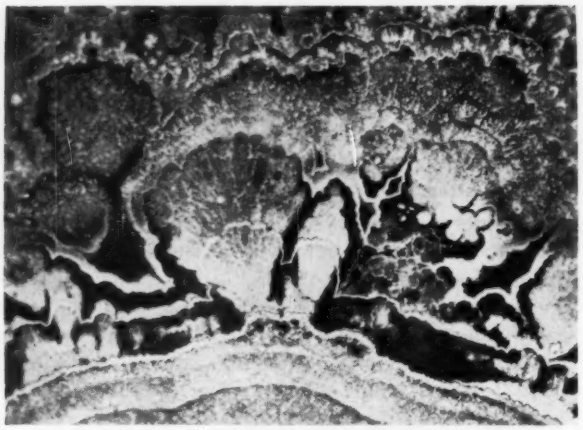


Figure 14. Brass Deposit X100.

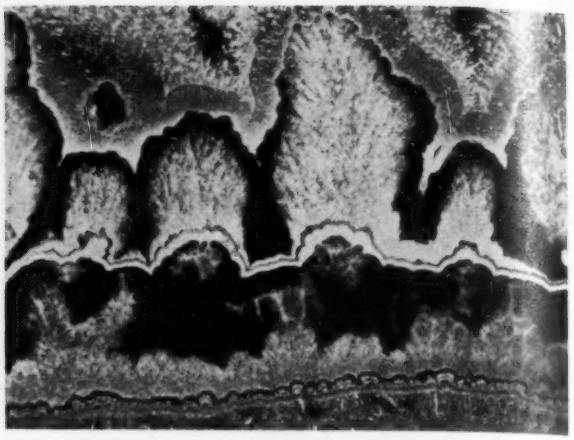


Figure 15. Brass Deposit X250.

tudes of which determined the grain size of the metal:

KZ Rate of nucleus formation per unit volume.

KG Rate of crystal growth in all directions.

It follows then that grain sizes varies as $\frac{KG}{KZ}$.

(As an extension of this, KG could be broken down into two other factors:

1. Outward growth — favoring fine grain size.
2. Lateral growth — favoring coarse grain size.

A differentiation between these two types of growth is the basis for much of the research work described by Finch and Layton.[3])

Growth of electrodeposit crystals on a surface is similar to crystallization of a molten metal against a surface, but is somewhat more complex as there are more factors operating. Wilman[8] gives the following useful tabulation of the factors affecting growth of deposits:

PRIMARY FACTORS

1. Rate of arrival and discharge of ions at cathode.
2. Mobility of ions over cathode surface.
3. Atomic arrangement of substrate.
4. Concentration of deposit on projections.
5. Extent and nature of adsorption or co-deposition of other ions, atoms, molecules and colloids.

SECONDARY FACTORS

a. Electrolyte concentrations.
b. Temperature.
c. Current density.
d. Degree of stirring and convection.

The secondary factors can be seen to be those affecting one or more of the primary factors which in turn decide the ascendancy of either KZ or KG. Effects of various factors will now be considered in detail.

Effect of Plating Conditions on Grain Size

Once the deposit has been established on the basis metal, assuming it has overcome the orienting effect of the basis-metal crystals, its growth depends mainly on the first and fifth of the primary factors which are themselves controlled by the plating conditions listed as secondary factors in the table. A considerable amount of experimental work by a number of investigators[1,7,9,10,11] has established certain general rules governing the effects of the various secondary factors on grain size. These can be summarized broadly in the following statement: "*Any condition tending to increase the supply of ions available for discharge at the cathode favors large grain size.*"

1. ELECTROLYTE CONCENTRATIONS. The type of electrolyte plays a very big part in determining grain size. There are two main classes covering the majority of commercially used plating solutions, namely, acid and cyanide. Deposits from acid baths (for example, copper and nickel) are normally large-grained, columnar and, incidentally, are frequently twinned (Figure 16). Cyanide baths, on the other hand, invariably give very fine grained, often microscopically irresolvable, de-

(*Continued on page 59*)

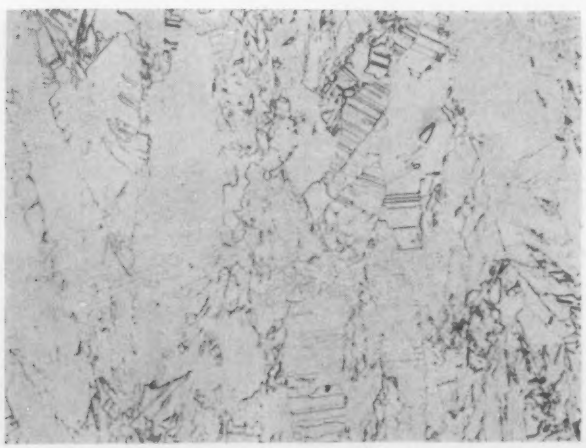


Figure 16. Copper Deposit showing Twinning X250.

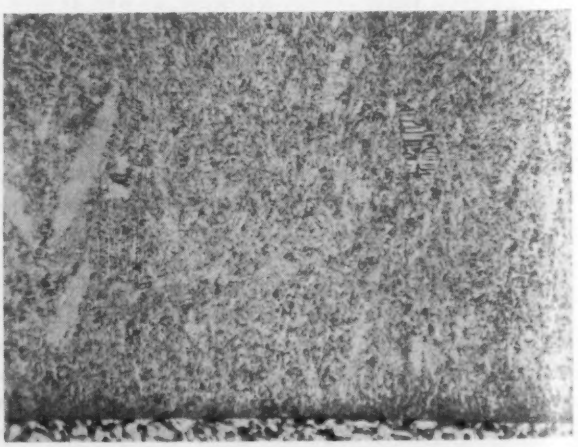


Figure 17. Acid Copper Deposit X250 Bath Temperature 20° C.

Electroplating on Zirconium*

By W. C. Schickner, J. G. Beach and C. L. Faust, *Battelle Memorial Institute, Columbus, Ohio*

Introduction

METHODS for plating on metals such as chromium, stainless steels, aluminum, or magnesium are not applicable for plating on zirconium. Zirconium is resistant to acids and alkaline solutions, except hydrofluoric acid.

Method for Producing Adherent Electroplates on Zirconium

General Comments

Electroplated metals on zirconium prepared by conventional procedures for plating on other metals are electroformed shells and can be separated or peeled easily. Heat treatment of these electroplate-zirconium composites resulted in localized blistering or over-all separation at the electroplate-zirconium interface.

Adherent electroplates on zirconium (50,000 psi, as indicated by modulus of rupture are produced by a prescribed etching of the zirconium surface, nickel or iron plating, prebaking, and heat treating to alloy bond the interfaced layers of the two metals. Other metals may be electroplated over the nickel-plated or iron-plated zirconium as desired.

The following general procedure (discussed later in greater detail) is recommended for producing adherent nickel electroplates on zirconium:

1. Descale. (*a*) Sandblast, (*b*) vapor blast, or (*c*) surface grind
2. Alkaline clean
3. Rinse
4. Chemical etch. Solution: NH_4F—18-52 g./l., HF—3-16 g./l.; molar ratio: NH_4F/HF, 1.2-4.1; temperature: 100°F. (38°C.); time: ¾ to 3 min.; metal removed: 0.6 mil.; container: polyethylene.
5. Rinse
6. Nickel plate. Solution: $NiSO_4 \cdot 7H_2O$—330 g./l., $NiCl_2 \cdot 6H_2O$—46 g./l., H_3BO_4—37 g./l., H_2O_2—added periodically to prevent pitting, pH 2.0; temperature: 140°F. (60°C.); current density: 40 amp./ft.^{2}; plate thickness 1-2 mils.
7. Rinse and dry.
8. Prebake. Temperature: 400°F. (204°C.)—air is o.k.; time: 2-4 hours.
9. Heat treat. Temperature: 1300°F. (704°C.)—air is o.k.; time: 10-15 min.; quench: air or water.

Preliminary Surface Preparation

Descaling.—After fabrication at elevated temperatures, zirconium retains an adherent, chemically resistant skin. No aqueous chemical method was found to remove this skin without pitting the underlying zirconium. Mechanical removal of this skin by sandblasting, vapor blasting, or surface grinding is satisfactory.

Chemical polishing.—Chemical polishing of the zirconium was considered for improving the zirconium surface for plating. Bright smoothened surfaces were produced by immersion in dilute solutions of hydrofluoric acid (4% HF). However, chemical polishing had little or no effect on the as-plated adhesion or on the diffusion bonds.

Since chemical dissolution in solutions of hydrofluoric acid alone is rapid, a more easily controlled chemical polishing solution was investigated. The following solution chemically polishes zirconium, and the rate of metal removal can be controlled by the temperature of the solution: NH_4FHF—100 g./l.; HNO_3—400 ml./l.; H_2SiF_6—200 ml./l.; H_2O—to 1 liter.

The approximate rate of metal removal vs. temperature is as follows:

70 to 80°F. (24°C.)	0.0006 in. removed/min.
80 to 85°F. (28°C.)	0.0008 in. removed/min.
90 to 95°F. (33°C.)	0.0018 in. removed/min.
100 to 110°F. (40°C.)	0.0025 in. removed/min.
110 to 120°F. (46°C.)	0.0040 in. removed/min.

Cleaning.—Electrolytic or soak alkaline cleaning is used to remove surface dirt.

Etching of Zirconium Prior to Plating

Good as-plated adhesion and the best diffusion bonding depends on proper etching of the zirconium surface prior to electroplating. Etching in solutions of ammonium fluoride and hydrofluoric acid is satisfactory. However, the molar ratio of NH_4F:HF is important. Molar ratios of 1.2 to 4.1 are recommended. The effects of concentration and molar ratio of ammonium fluoride and hydrofluoric acid on the as-plated adhesion are as follows:

NH_4F, Mole/l	HF, Mole/l	NH_4F/HF, Molar ratio	As-plated adhesion, psi
0.00	0.50	0	<1000
0.44-0.88	0.44-0.88	1.0	<1000
0.49-0.98	0.40-0.80	1.2	>6000
0.66-1.32	0.25-0.44	3.0	>6000
0.83	0.05	16.6	<1000
1.67	0.09	18.8	<1000

Etching for ¾ to 3 min. at 100°F. to remove about

*Based on work performed under AEC Contract No. 7405-eng-92. Reprinted from *Journal of The Electrochemical Society.*

0.6 mil. of the surface is recommended. The time of etching is dependent on the amount of free HF in the solution. About 0.6 mil. is removed in ¾ min. in the solution containing 36 g./l. NH_4F (0.98 *M*) and 15.5 g./l. HF (0.78 *M*), whereas 3 min. are required in the solution containing 52 g./l. NH_4F (1.4 *M*) and 7 g./l. HF (0.35 *M*).

Electroplating

Nickel.—Electroplating on zirconium from wetting-agent-free baths is recommended. Although wetting agents (and probably other organic additions) in the plating bath do not appear to affect the as-plated adhesion, their inclusion in the diffusion alloy results in a 20 per cent weaker bond.

The recommended electroplate thickness is 1 to 2 mils. About 0.5 mil. of the electroplated metal is alloyed with the zirconium in a subsequent heat treatment. Heavy electroplates tend to separate from the zirconium during heat treatment because of the difference in thermal expansions of the two metals.

Iron and other metals. — Since nickel, diffusion bonded to zirconium, is a satisfactory basis for subsequent plating with more nickel or with other metals, the emphasis in this work was with nickel. However, iron can be successfully electroplated on and diffusion bonded to zirconium.

Copper and silver directly on zirconium were also investigated. Copper electroplated on zirconium appeared well bonded after hot rolling. Silver and zirconium did not show any alloying until about 1850°F. (1010°C.), at which temperature a low-melting, eutectic alloy formed. Simple heat-treatment diffusion bonding of electroplated copper or silver to zirconium is prevented by the low solubility of hydrogen in copper and silver resulting in blistering.

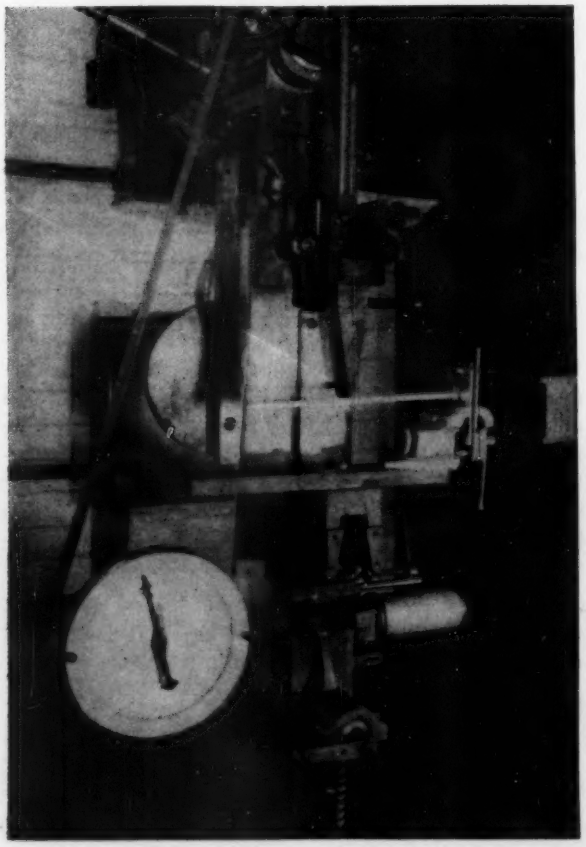


Figure 1. Silver-solder-test setup with a specimen clamped in the Amsler testing machine and ready for breaking.

Prebaking

To prevent blistering of nickel and iron electroplates on zirconium caused by rapid evolution of hydrogen during diffusion heat treatment, prebaking at 400°F. (204°C.) is recommended. Specimens diffusion bonded within a day or two after plating and without prebaking generally blistered. Others held at room temperature for three weeks or more before diffusion bonding showed only limited blistering. Prebaking at 400°F. (204°C.) for 2 to 4 hours eliminated blistering. A one-hour prebake was insufficient.

Three hydrides of zirconium have been identified by electron diffraction of zirconium cathodically pickled in dilute sulfuric acid. The surface showed ZrH_2 over layers of ZrH and Zr_4H. Probably, hydrides are formed during etching of and plating on zirconium. This hydride formation is reversible and explains the necessity of prebaking. In addition, it partially explains why electroplated copper and silver on zirconium were not satisfactorily diffusion bonded. The low solubility of hydrogen in copper and silver prevents outgassing through the electroplate and allows concentration of the hydrogen and separation at the copper- or silver-zirconium interface.

Diffusion Heat Treating

The strength of the alloy bond is related to the amount of diffusion. The effects of heat treatment on the diffusion-alloy bond are as follows:

1100°F.	240 min.	No bond
1200°F.	240 min.	Good bond
1300°F.	45 min.	Good bond
1500°F.	<5 min.	Good bond
1300°F.	240 min.	Fair bond
1500°F.	45 min.	Fair bond
1500°F.	240 min.	Poor bond

Good bonds are about 50,000 psi (modulus of rupture), fair bonds are 35,000 psi, and poor bonds are 5,000 psi.

The best diffusion bonding of electroplated iron on zirconium occurs at 1500°F. (816°C.) in 10-45 min.

Experimental Methods

Design of Experiments

The development of a reproducible process for diffusion bonding electroplated nickel to zirconium required the selection of proper conditions. Since many ramifications are involved, most of the experiments were of the factorial type (1) and were subjected to analysis of variance.

Test of Adhesion

Qualitative adhesion tests such as filing or grinding the edge of a sample, bending a sample to fracture, sawing, and wire-brush burnishing were initially used. However, the results depended upon the thickness of the electroplate and upon its physical properties. Several quantitative tests were considered, but generally were not adaptable to rapid testing.

Numerical results were needed for an analysis of

Figure 2. Silver-solder-test assemblies before and after testing.

variance. Therefore, soft- and silver-solder tests were used to estimate the comparative strengths of the electroplate-zirconium bonds. For the silver-solder tests, the end of an alloy-steel bar (¼-in. square by 10 in. long) was silver soldered (mp 1070°F.) so as to be perpendicular to the sample being tested. In a 1000-lb. Amsler testing machine, the bond was broken by applying a known force perpendicular to the steel bar at a distance of six inches from the silver-solder joint. The test setup is shown in Fig. 1. Samples before and after testing are shown in Fig. 2.

For the soft-solder tests, $\frac{3}{16}$-in. brass rod was soft soldered to the sample being tested. The electroplate-zirconium bond was tested by hanging known weights on the brass rod 6 inches from the solder joint.

The soft-solder test was used to evaluate as-plated adhesion. Since the soft-solder test was not severe enough, the silver-solder test was used for diffusion-bonded samples. The short-time heating during soldering did not appear to influence comparative evaluation.

To obtain data for calculating a modulus of rupture, a series of samples were prepared with the plated area being tested isolated by bandsaw cuts through the silver solder and the electroplate into the zirconium. So, in effect, the area being tested became an integral part of the steel test bar.

For calculating the modulus of rupture, the flexure formula, $S = MC/I$, was used. S is the modulus; M is the bending moment; C is the distance from the neutral axis to the outermost fiber of the test area; and I is the moment of inertia of the test area.

Reference

1. K. A. Brownlee, "Industrial Experimentation," 3rd American ed., Chemical Publishing Company, Brooklyn, New York (1949).

THE STRUCTURE OF DEPOSITS

(*Continued from page* 56)

posits. This is because the metal in any cyanide bath is always present in a complex ion, which itself is only very slightly ionized so that the actual metal ion concentration is extremely low.

These remarks apply equally to other types of baths based on complex ion formation, but cyanide baths are by far the most common and typical of these. In a given solution, increased metal content favors large grains; should the degree of ionization be decreased, for example by addition of another salt giving the common ion effect, then grain size is reduced. Changes in acidity or alkalinity of solutions do not appear to give consistent effects[7,11].

2. Current Density. Increased current density favors reduced grain size because the increased rate of deposition depletes the metal ion content of the solution more rapidly in the vicinity of the cathode. There are occasional exceptions to this rule, for example, in the case of nickel plating solutions in a certain pH range[11].

Gardam[12] imagines the discharged ion being accommodated either in an existing crystal lattice or assisting in the formation of a new lattice. Potential versus current curves for an acid copper electrolyte show a straight portion at low current densities where he supposes ions build on to existing grains, giving a coarse structure. At higher current densities the curve assumes a logarithmic shape, where discharged ions shows a greater tendency to form new lattices giving a fine grained structure.

3. Temperature. Increased bath temperature causes a very marked increase in grain size, due mainly to the increased mobility of the ions, which can thus more readily make good the depletion in the ion concentration in the cathode layer of liquid. The effect of temperature on grain size is readily seen by comparison of Figures 4 and 17 illustrating copper deposits produced at temperatures of 50°C. and 20°C., other conditions being unchanged.

4. Agitation. Agitation favors increased grain size for much the same reason as does temperature, that is, it assists in the bringing up of fresh metal ions to the cathode layer.

Several investigators[7,9,10,11] have shown that considerable changes in hardness accompany changes in grain size. These hardness changes are greater than would be expected from experience with annealing wrought metals. An explanation for this phenomenon is found in the inclusion of foreign matter in the deposit. This subject will be dealt with in a later section of the paper.

(*To be continued*)

Plating in the Automotive Industry: Its History and Development

By William M. Phillips

Mr. Phillips, retired head of the Electrochemical Dept. of General Motors Research, is best known for his efforts to improve the standards of commercial electroplating, and for developing copper and nickel plating baths. He was the first to publish an article on low pH nickel baths.

He is a past president of the American Electroplaters' Society and has twice won the AES Gold Medal, plus a special Navy Award for Meritorious Service.

THE idea of having an automobile goes quite a distance back — almost as far as the idea of flying, which is in the Bible as the wish of the Psalmist for the wings of a dove. Roger Bacon in 1250 prophesied the coming of horseless carriages. In 1560 is the prophecy of Mother Shipton, "Carriages without horses shall go." In 1619 an English patent was granted to Ramsay and Wildgoose for "drawing carts without horses." It is an interesting thought if they had kept on improving the idea and taking out patents, how much royalty would they and their heirs have collected by now? The earlier cars were to be propelled by steam, and some of them were! In 1800 Sir George Medhurst patented an explosive (gun powder) engine. This idea seemingly was sound, as automotive progress has been mostly based on exploding materials in cylinders. In 1820 Farish and Cecil built "explosion engines" using hydrogen gas.

So the seed was planted and was growing the hard way for many years. As early as 1860 Lenoir of Paris "perfected" the gas engine using electric spark ignition, and actually drove in a carriage for the astounding distance of three miles. Various mechanical devices filtered into the picture and resulted in phases of improvement leading to the manufacture of a really successful automobile. In 1867 Thompson "placed pneumatic tires on steam carriages." Without pneumatic tires the automotive industry could not have developed as it has today. In 1879 George Selden was the first to apply for a patent in the automotive industry. This patent did not produce a commercial automobile, but it did stir up quite a lawsuit.

So much for the early days. Harold F. Blanchard, technical editor of "Motor" said in an article in 1942 that "we might say that our automobile industry began 50 years ago when Charles E. Duryea built the first American gasoline car in 1892. It was a typical buggy with high wheels, a patent-leather dashboard, a folding top, tiller steering and a single-cylinder horizontal engine in the rear which drove the back wheels by means of side chains operated by a cross shaft. There are other contenders for first American honors including Elwood Haynes, but the odds are in Duryea's favor."

Mr. Blanchard makes the following statement about the work of George Selden which is interesting: "Although Duryea gets the credit for making the first American automobile that would run, it is true that years before George B. Selden built a gasoline automobile that would not run. Selden was an obscure patent attorney in Rochester, N. Y., who, sensing the future, applied for a patent in 1877 on a "combination" of a gasoline engine, clutch, transmission and driving mechanism for a motor vehicle. In those days a patent application had to be accompanied by a working model and so Selden built a full-sized one.

"By making leisurely amendments to his patent claims he was able to delay the issuance of the patent until 1895 when the gasoline automobile was well on its way to success. Sometime after his patent was granted the Association of Licensed Automobile Manufacturers was formed, the members receiving a license under the patent in return for substantial royalty payments.

"Most of the leading American manufacturers joined the association but Henry Ford objected. The association sued Ford, but after a legal battle lasting for years,

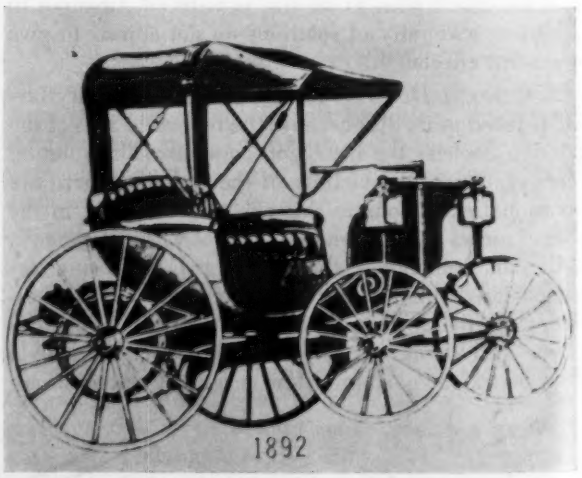


Figure 1. Duryea's car.

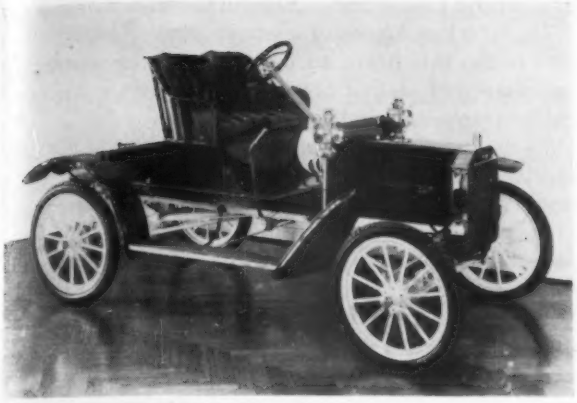


Figure 2. Ford, vintage 1902.

Ford won when the Supreme Court of the United States decided against the Selden patent in 1911."

I have confined my remarks to the gasoline driven cars. There were steam and electric cars, which in the early days had some notable advantages over the gas buggies, among which were that they were much quieter and did not smell so bad. One has to be an old-timer to remember that our earlier automobiles did smell bad. Perhaps they do now, but we just got used to it, just as the people at Niagara Falls do not hear the noise of the falls. However, in 1900, at Chicago, a gasoline automobile beat the electric and steam cars in a free-for-all. The first recorded car sale I have been able to find was by Winton — "April Fool's day" — 1898, to Robert Allison. I do not know how the car ran!

Although the danger of monoxide poison was not realized, there was a case in 1900. Mr. Frank, an automobile owner in Yonkers was overcome in his barn by some mysterious gas. In 1902 the law caught up with the first speeder in Minneapolis when Thomas H. Slevlin was fined $10 for exceeding the speed limit of ten miles per hour in his new French car. His defense was that he was travelling at the lowest possible speed. He paid up, setting a pattern which has been lived up to ever since. Omaha, Nebraska excluded cars from its parks due to accidents. In 1903 three men crossed the continent in automobiles, one driving a Packard, one an Oldsmobile, and the other a Winton — time 61 days. In 1900 automobiles looked like buggies. By 1904 they looked a little more like an automobile as we know it today.

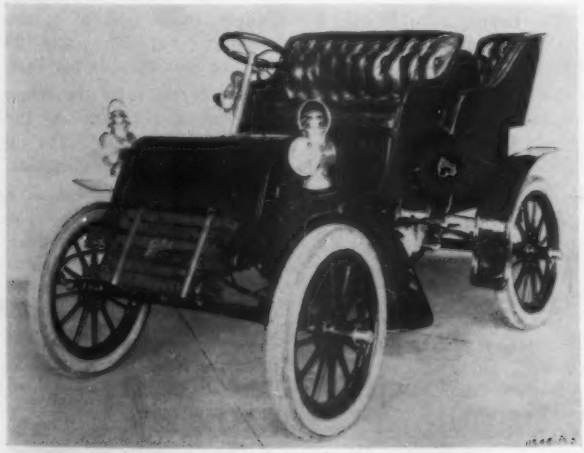


Figure 3. Cadillac, vintage 1904 (wheel base 72").

On Bicycles But Not on Cars

Not much plating was done on these early cars. Ford on the 1902 model had nickel plated the crank for the underseat engine. This is the first reference I have been able to find to the plating of automotive parts, but it surely is not the last one.

Now let us look at some pictures of 1904 models. The specifications of some 1904 automobiles are interesting in view of what they are in 1954.

Name	*Max. H.P.*	*Wheel Base*	*Wt.*
Buick	22	84″	1350
Cadillac	8		
Ford	10-24	92″	
Nash	7-18	78-90″	1250
Olds	4½-10	72-82″	650-950
Packard	12-22	94″	1870-2200
Maxwell	8-14	72-82″	760-1600
Studebaker	16	88″	1550
Willys Overland	5	78″	600

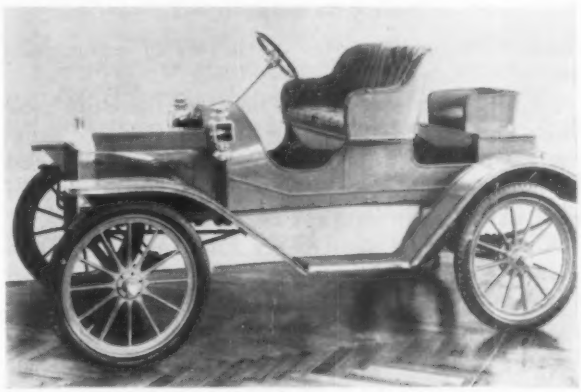


Figure 4. Fords of 1907 and 1908 had nickel plated wick holders in the kerosene lamps.

Some of our companies that have been successful were organized in the early part of 1900. Some of these might well be mentioned: Olds Motor Works, 1901; David Buick established Auto Vim and Power Company, 1901. This later became the Buick organization. Cadillac was organized in 1902; Studebaker, 1902, but started by building electric runabouts and trucks. Ford Motor Company was organized in 1903 and Maxwell in 1904. These are just a few of the many companies. The National Association of Automobile Manufacturers had a membership of 112 which grew rapidly — more of this later.

In 1905 there were registered 9153 gasoline driven cars of American manufacture and 597 of foreign make. In 1908 there were 175 automobile manufacturers whose combined production was 50,000 cars which by 1910 grew to 290,000 cars.

General Motors Co. was organized on September 16, 1908, a few months later than Fisher Body.

Plating Catches On

In 1911 and 1912 was a turning point in the industry. The patent squabble was over and a vigorous program of standardization was started by the Society of Automotive Engineers. There never was a more competitive industry, but there also existed and does exist today, a good spirit of friendly co-operation and

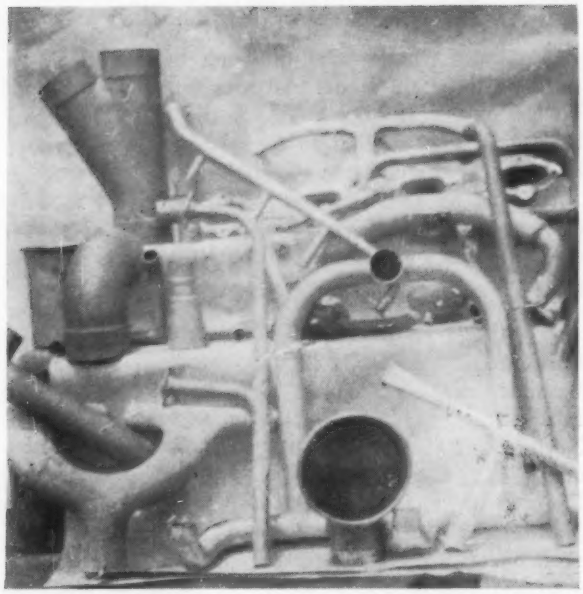


Figure 5. Electroformed parts, made in 1913 by Inland Metal Products Co. of Detroit, Mich.

standardization that saves the buyers of automobiles tens of millions of dollars every year.

In 1912 there appeared in the trade literature comments such as, "designers are turning from the ornamental and hard to polish brass to enamel and nickel plating." Thus plating was starting to fill a need of what was to be an immense use of plated products.

About this time the stronger automobile companies started to pull ahead and there were many failures of those who, for one reason or another, could not keep up. In this race it must have been pretty difficult to pick the right horse, so don't be too sorry for yourself if you did not make a fortune by investing in some automobile company. Remember that in the old days there were 175 manufacturers of automobiles whereas today there are less than ten.

Before 1912 there is not much mention of plating in the engineering specifications for building cars. Olds and Cadillac mention the use of nickel plating on a few parts in 1907. Ford mentions the plating of wick holders in kerosene lamps. Not much headlight glare in those days in spite of the nickel plating. By 1912 there was quite a bit of plating used on cars. This did not occur suddenly but was a development from the early beginning in the preceding ten years. Among the plated parts which might be mentioned are: radiator shells, headlamps, windshield hardware; also zinc plating as a protective coating for parts which were either concealed or unimportant from an appearance standpoint.

The Cadillac came out with a self-starter in 1912 and at the same time used electrodeposited copper manifolds which constituted quite a lot of plating. These manifolds were furnished by the Inland Metals Products Co. of which the writer was general manager (Fig. 5). The deposit was fifty thousandths of an inch thick. The part constituted the first plating the writer ever did for the automotive industry and was the thickest deposit they have required in my forty years of experience. Other companies used electro deposited manifolds among which might be mentioned the Haynes Co. of Kokomo, Ind. It might be interesting to note that Inland deposited all the voice tube appliances used by the United States Navy in the first World War.

In 1914 the American Electroplaters' Society came into being, this being an indication of the increasing importance of plating not only by the motor industry but by many other industries.

In these early days plating was bought without any specifications and it was not until the advent of the salt water spray test promoted by the National Bureau of Standards, that any specifications were used. This happened about 1918 or 1919. This test put the platers on the spot, I might mean spots of rust. It was a valuable test and still is, for if the test has many shortcomings, it has shown vastly more shortcomings of plating which

Number 101
Date Issued 9-22-24
Replaces issue of 5-15-24

Method
SPECIFICATION
Issued by M. and S. Dept. For
COPPER PLATING CAMSHAFTS

At Detroit

To Clean Camshafts

Use Studebaker Cleaner #2, 3 oz. per gal., using the current direct from the generator. The tank forms the positive connection, the camshafts the negative. Temperature should be 180° F. Rinse in boiling water, keep tank overflowing during rinsing operation.

Acid Dip

1 pound Kleanrite.
1 pound Sulphuric acid per gal. of water. Submerge shafts 2 minutes.

Water Rinse

Rinse in cold water. Keep water overflowing so as to prevent contamination with acid. Hang in plating bath immediately after removal from rinse tank.

Plating Solution

Warm alkali cyanide.
Formula for making up new solution:

Sodium cyanide—5 oz. per gal.

Copper Cyanide—3½ oz. per gal.

The copper cyanide used is the compound cupro-cupric cyanide.

To maintain solution in good working order, analysis should be made every day for free sodium cyanide and metallic copper.

Below analysis represents a good working solution:

Copper (metallic) 20 grams per liter.

Sodium cyanide equiv. to 28 grms. per liter of copper cyanide.

Sodium cyanide 18-20 grms. per liter.

At South Bend

To Clean Camshafts

Wash in boiling solution of Cleaner #3 to remove oil and grease.

Rinse in hot water.

Hang in Kleanrite solution containing ½ pound of Kleanrite A and ½ pound of concentrated sulphuric acid per gal. of water until the entire surface of the camshaft shows that it has been acted upon. Depending upon the condition of the solution the camshafts should be subjected to the action of the Kleanrite solution from five to ten minutes.

Rinse in hot water and hang in plating bath as soon thereafter as possible.

Plating Solution

When made up fresh this solution contains 3½ oz. of copper cyanide and 5 oz. of sodium cyanide per gal. of water. As the solution becomes older both of these components increase in value and tend to seek their own equilibrium.

At present the bath contains 27 gms. of copper (equiv. to 37 gms. of copper cyanide) per liter, and 25 gms. of free cyanide per liter.

Condensate from the steam coils used for heating the solution is used to make up for the losses of evaporation.

The solution is kept at a temperature of 126°. The solution is circulated and filtered continuously by means of a circulating pump to which the filter is connected.

Twenty-two oz. of sodium cyanide (98%) are added to the bath with each lot of forty camshafts.

Figure 6. Specification for copper plating camshafts for selective hardening issued in 1924.

has led to many improvements in the product. It was really an important milestone in the development of more durable plated coatings.

Since specifications are so important in showing progress, I will not spoil the story by talking about them now but will cover this in a chapter on specifications later, thus giving a view of the progress in our industry in concentrated form.

Application of Plating Broadens

The bright work in our early cars was brass which had to be kept polished by the owner. The trend thus established kept on through many years although the parts were later plated. To mention some of the important parts which prevailed through many years, some of them even up to and including the present, are as follows: radiator shells, lamps, lamp rims, lamp bodies and headlamp reflectors, hub caps, radiator caps and later came bumpers, a most important use of plating. This occurred with a start in 1912-13. The first instance I have been able to discover were bumper cuffs and bumpers made by Lyons, Inc. of Detroit.

Into the picture also came the so-called automobile jewelry consisting of handles, both outside and inside, made of zinc base die castings which were copper and nickel plated. Some were both enameled and plated. The Sheppard Art Metal Co. came from the east and located in Detroit and were an important factor in this development. Some of their earlier work was silver plated.

Between the years of 1912 and 1922 was a decade of great development in the use of plating by the automobile industry. Previously I have referred only to decorative parts, but there were very important uses of plating for functional purposes. The use of zinc and cadmium became quite important on standard parts such as screws, bolts and nuts, tire rims, and other parts. Barrel plating and the use of conveyor plating machines started to come into general use to furnish the ever growing demand.

The metallurgical use of copper plating to mask off sections of parts in carburizing was quite general by the end of this period (Fig. 6). The mechanical use of plating which is unseen is still very important and has become more so as the years have gone by. In 1922 it was not uncommon for the areas plated largely for protection or utility only, to equal or exceed those plated for decorative effect. This is true when you consider the fact that demountable tire rims were zinc plated as were rim wedges and other standard parts.

Jaxon Steel Products and Firestone both had large conveyor units to plate rims and rim parts at this time. It might be interesting to know that this plating was originally done in an acid zinc sulphate bath with the acid content low, or if you like, pH high. It was discovered that, by increasing the acid content, much better and cheaper plating could be done. Parenthetically, I might remark it took us a long time to realize that the same thing was true of nickel plating. It was later found that cyanide zinc was still better for plating the clincher type rims which were then in vogue because of the superior throwing power.

In the decade with which we are now dealing the first World War occurred and, whereas it had some important effects on the motor industry and the plating industry, these effects were nowhere near as great as those of the second World War to come. There were steel restrictions and other scarcities and an important element of the motor industry shut down its car manufacture for a time to complete war contracts. There were gasless Sundays. It is questionable what effect this war period had on plating except to find new uses for it. The ensuing depression of 1919-21 was probably overcome by the courage and optimism of the automobile industry as much, if not more, than anything else.

It was in 1921 that the writer was hired by General Motors Corp. and thus was given facilities and means to assist in the development of finishing automobiles. It was also about this time that the writer accepted a

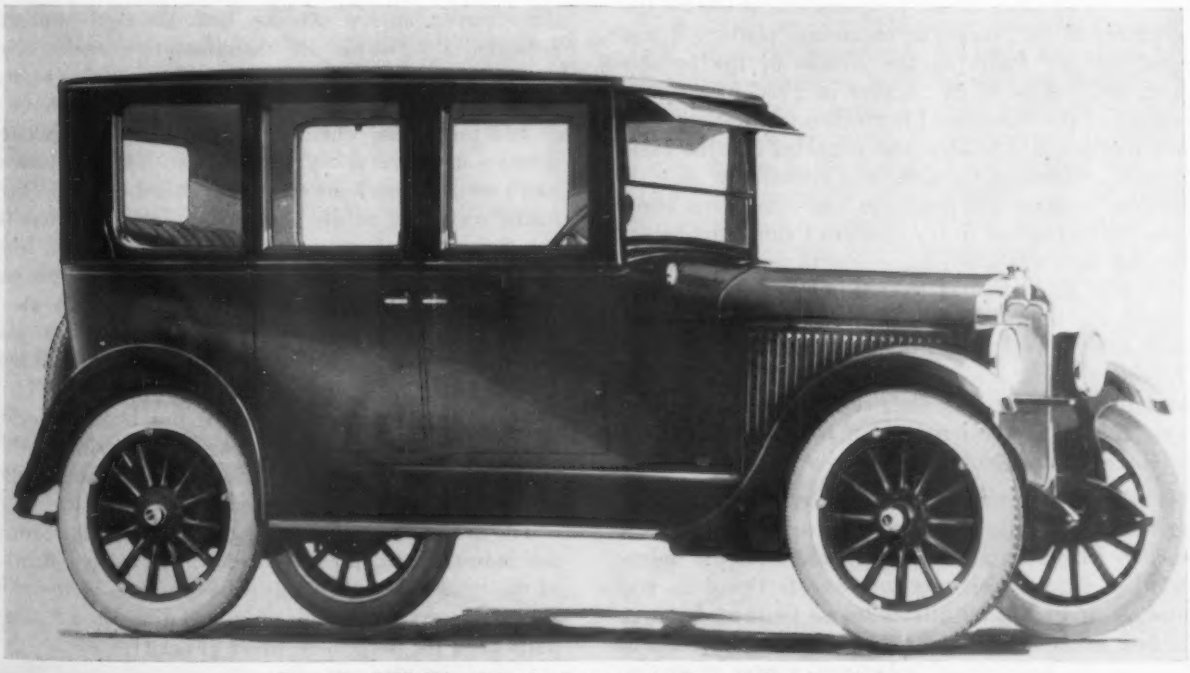


Figure 7. 1925 Oldsmobile, the first example of use of chromium plating.

job to teach classes in plating under the auspices of A.E.S. at the Cass Technical High School. This class was largely made up of platers from the automotive industry and, as is often the case with the teacher, he learned more than he taught. It became a forum on the plating of car parts for the industry. One student stated that he was getting more nickel from a fluoborate solution than Faraday's Law would permit. After quite a few experiments, it was decided that Mr. Faraday's Law was correct. It doubtless would have been a great comfort to Mr. Faraday, had he been living.

In the period of 1922-32, advances were made which might be enumerated as follows: (1) chromium plating. (2) Increase in the severity of plating specifications and consequent improvement in the life of plated parts. (3) Low pH nickel solutions. (4) Great increase in use of conveyor equipment. (5) Advent of plated radiator grilles and elimination of plated radiator shells. (6) Increase in the area of bumpers. (7) Improvement in the plating of zinc base die castings. (8) Stainless steel vs. plating.

Chromium Plating Arrives

Chromium plating was first used in production line quantities in the automobile industry by Oldsmobile in 1925. The first pieces to be plated were lamp parts. Nothing was done to acquaint the purchasers of the car that there was any chrome plating on it. However, it was not very long before a pronounced customer reaction turned up. Remarks such as the following were common: "The nickel plating on the lamp stands up better than the nickel plating on the other parts of the car." In view of this and the very excellent results obtained by laboratory tests, it was decided to plate the radiator shells and lamps of the entire 1926 productions.

There were naturally some difficulties, though considering the newness of the process, these were not very great. The General Motors point of view varied from those of some of the people working on the development of the process of chromium plating. It was found that by following the outline of the process which was published by Sargent in 1920 in the proceedings of the American Electrochemical Society, that good results could be obtained, provided that the basic material, chromium trioxide, was reasonably pure. It therefore became the policy to purchase pure chromium oxide and not to try to correct sulphate content after the bath was made up, except to replace chromic oxide and sulphate lost by use and drag out. This method was followed by others in the industry, while many others used the process promoted by United Chromium who have done much to extend the use of chromium plating in the industry. The author expects to collaborate in the write up of the early history of chromium plating development at a later date.

It might be interesting to know why chromium plating was so welcome to the automotive industry at this time. In 1923-24 a great change came over the industry when Duco finish was introduced. Duco, as you know, is one of many nitrocellulose finishes, but was the first to be used in the automobile industry. Up to this time the painting of a car was a very expensive and laborious job. Some cars used as many as twenty coats of paint and varnish. Huge equipment involving dip tanks and ovens were used to take advantage of the cheaper and sometimes better, baked asphaltic enamels. Practically all manufacturers used black enamel fenders and many car bodies were also treated the same way.

Number 129A
Date Issued 9-12-27

Method
SPECIFICATION
Issued by Eng. Dept. For
CHROME PLATED PARTS

General

1. The surface of all parts to be Chrome Plated must be free from scratches, deep tool marks or any other defects affecting the permanency or appearance of the Chrome Plated surface. All parts must be buffed free from these defects before plating or else be rejected.
2. All steel parts must be copper plated and buffed and nickel plated and buffed before applying chrome plating. When chrome plating brass or bronze the copper plate may be omitted, but otherwise proceed as with steel parts.
3. The purchaser reserves the right to submit all chrome plated parts received to the following inspection and tests. Failure to pass any of them may be cause for the return of the shipment or any part thereof for full credit plus carrying charges both ways.

Shop Inspection

Samples of each shipment of chrome plated parts received will be sent to the laboratory and OK from laboratory on regular "Request for test" form must be received before releasing for production.

Laboratory Inspection

1. The laboratory will examine samples for copper, nickel plating and chrome plating.
2. All chrome plated steel parts will be subjected to a 20% salt spray test for a period of 48 hours and must show no signs of corrosion. If found not to conform to these specifications the shipment will be rejected and a report submitted to the purchasing department for disposition of the rejected material.
3. Steel parts which are chrome plated for other purposes than ornamental will be plated direct omitting copper and nickel undercoats.

Figure 8. First specification for chrome plated parts for the 1928 Studebaker.

You might ask what has all this to do with chromium plating, but it has a lot to do with it. The painted and varnished portions of the car failed to retain their lustre very long as did the nickel plating so that the car finishing program was not on too high a level. When Duco and nitrocellulose finishes came into general use, the durability of plating had to catch up. If it had been the other way about and chromium plating had previously been available, cars would have looked rather queer with dull paint and bright chromium after a few months use. It has been remarked that they would have looked like a mule with a white collar. This, of course, referring to the radiator shell which was so extensively used at this time.

The use of chromium plating spread rapidly through the industry and, for instance, here is a specification of the Studebaker Company who was one of the chief manufacturers to use chromium plating on all plated parts used for decorative effect (Fig. 8).

Chromium plating was greatly misunderstood by the

public in the early days. It was not realized that, for decorative plating, chromium is merely to protect the other plated metals from turning dull in use. Plating with other metals was, and still is, relied upon to protect the base metal whether it should be of steel, zinc base die casting or brass. The usual thickness of decorative chromium plating is ten millionths of an inch or less, but covers a thickness of one thousandth of an inch or more of copper and nickel when steel and zinc die cast parts are plated. On brass it only requires about two ten thousandths of an inch of nickel under the chromium to get good results.

The advent of chromium plating had a great impact on the plating of other metals. It really taught us how to plate nickel and copper as they should be plated. The late Edwin M. Baker of the University of Michigan wrote a paper for the Electrochemical Society which clearly shows the adverse effect of trying to plate too much chromium on plated nickel. It is possible that it may be the effect of hydrogen which is involved in chromium plating, this due to the inefficiency of the operation. Only about 10-15% of the power used in this operation is usefully employed in depositing metal and the remainder is used to break up water into hydrogen and oxygen.

It is indeed hard to estimate the importance of chromium plating to the industry. With the greater durability of organic finishes and the practically untarnishable chrome plate, the automobile industry has something to offer the public of enduring beauty. That is, of course, if you and the other fellow avoid each other and telegraph poles when you are driving.

In addition to the decorative use of chromium, there developed a number of mechanical uses. It was found that by plating such tools as plug gauges with chromium about one thousandth or more thickness, the life was increased 100% or more. One of the first users of this process for plug gauges was the Buick Division of General Motors.

Many other tools were successfully plated with the so-called hard chromium and, in addition to this, some production parts were plated. This mostly on parts ground undersize. One company that I know of recovered hundreds of thousands of dollars worth of bearings that were accidentally finished undersize. Thus the putting-on tool was available to industry. The president of one large company refused to have such an installation put into his plant, stating that he did not want any way for his organization to cover up mistakes made in the shop.

The demands of styling sections required more and more bright parts on automobiles so that production started to reach such proportions that space became a problem.

Low pH Nickel Baths

The discovery of low pH or high acid nickel baths was a useful development to increase the efficiency of nickel plating in the sense that more amperage could be used per square foot of plated surface than had heretofore been the case. In the early 30's, nickel was practically all plated at relatively high pH. The famous book of Blum and Hogaboom at that time warned against plating in anything but high pH solutions.

It is true that Houdaille-Hershey Co. did plate, as I remember it, in a highly unorthodox way, using a solution in the neighborhood of about pH 4 as against solutions over 5, generally recommended.

In one of the divisions of General Motors, a very fortunate thing happened. The instrument for rating pH was mis-read and the solution adjusted to what later proved to be actually about 2.5 instead of 5.2 as the operator thought. Some strange things happened. It was possible to plate much more rapidly and smoothly than had hitherto been the case. Also, anodes which would scarcely dissolve or disintegrate in old high pH solutions were readily soluble in the low pH bath. There were two papers written by Clifton and Phillips which I modestly introduce as evidence, published in 1931 and 1932, Electrochemical Society Proceedings.

The use of low pH baths, which I may say has become quite general and matter of course, enabled the industry to again cut down its costs, due to higher speeds possible. Under this system much less floor space and tank equipment was necessary.

Of course it would be silly to say that there were no difficulties or disappointments in the use of low pH nickel baths. The disagreements were most pronounced. A technical officer of a large firm was asked what would happen if one tried to plate nickel in a solution of 2.5 pH or lower. His reply was that no nickel plate would be obtained at all. It is a pretty good example of how sure one becomes that they have to do things the old way, and often, as is true in this case, an accidental discovery completely upsets tradition.

Specifications, starting with merely an indication of how many hours salt spray test the piece would have to stand, become more inclusive as the years went on. This change was brought about partly by the work of A.E.S. and the Bureau of Standards as a result of the field testing done on panels at various locations, these locations being furnished by the American Society for Testing Materials which also cooperated in doing the work. It was found that thickness of plate was a very important factor in the durability of the resultant product. It was quickly learned that plating which measured less than one thousandth of an inch in thickness, particularly copper and nickel over steel, did not furnish adequate protection. A great deal of credit should go to Dr. William Blum of the U. S. Bureau of Standards in this work. A little later on in the article, I will furnish tables of specifications showing the progress of the industry.

(To be continued)

Simplified Waste Treatment Methods for the Electroplating Industry

By Dr. Leslie E. Lancy, *Consulting Engineer, Ellwood City, Pa.*

METAL finishing, especially electroplating operations, are increasingly coming under the pressure of federal and state laws requiring the treatment of polluting wastes. The problem is particularly great for the smaller plating establishments, because they are unable to meet the cost of the necessary engineering advice, invest in waste treatment equipment and add the expense of operating a waste treatment plant to their overhead.

With careful attention to all details and judicious approach to the problem, even the financially weakest plating plant need not fear that the expenses in connection with waste treatment will seriously interfere with future success or sound economical progress. Actually, waste treatment ought to improve operations in a number of important aspects and will teach sound economies with the chemicals in use, which might reduce overall operating costs.

To be efficient, a waste treatment plant doesn't have to be large or equipped with a large number of recording instruments and chromium plated guard rails. The aim of this paper is to bring waste treatment out of the realm of the experts and describe with simple terms the different phases of the problem. Since the modern electroplater has a well founded general chemical education, the field is not a strange one and an understanding of the underlying issues ought to help in future planning.

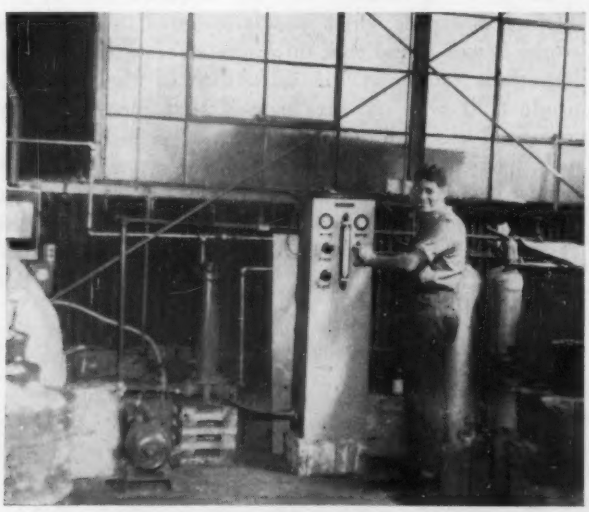


Figure 1. Chlorination equipment used in connection with a fully automatic zinc plating line.

The evaluation of a particular waste treatment problem depends a great deal on local requirements. Each state and municipality has set different standards to be met but, actually, the local requirements will be governed by what manner of receiver the waste is discharged into. In general three categories of receivers may be distinguished:

1. Streams and lakes used for fishing.
2. All other natural bodies of water and storm sewers.
3. Municipal sewage systems.

The first category receivers have the most stringent requirements. Usually it involves the reduction of all toxic compounds to a very low limit, the neutralization of all concentrated acids and alkalies, low suspended solids and organic material content. A clear effluent is required. To attain this quality, settling and possibly even filtration of the waste might be necessary after chemical neutralization and decomposition of the toxic compounds.

With the second category receivers the allowable limit of toxic waste content depends on the rate of flow of the waste waters in relationship to the rate of flow of the receiver. In other words the dilution factor is taken in consideration. Concentrated acid and alkali waste will have to be neutralized, the precipitated salts settled and the sludge otherwise discarded. Normally the treated rinse waters will not have to be settled, unless the quantity of suspended solids is so high that the effluent is discolored. Oil and grease contaminants

should be withheld from the outflow with skim boards or dams.

For the third category receivers the requirements are usually quite lenient. In large municipalities and with electroplating installations of relatively low water consumption rate, the dilution factor is so high, that scrupulous waste treatment is not necessary.

Since a great majority of electroplating installations are established within city limits and are at the present time using the municipal sewage system for their drain discharge, a thorough discussion of this category of receivers is important. Low concentrations of toxic compounds, suspended solids, normal oil and grease contaminations may go through the municipal sewage treatment plant without any harmful effects.

Chromic acid, cyanide compounds, metallic salts such as copper, cadmium, and zinc are poisonous to the living organism on which the treatment process depends. The dumping of a chromium plating or cyanide solution might reduce the biological activity of the bacteria in even the largest treatment plant, impairing the health of a large community. Large concentrations of cyanide compounds might release poisonous hydrocyanic acid gas in the city sewer lines due to acid conditions, resulting in a serious hazard to the maintenance workers in the sewer canals. Acidic wastes are highly corrosive to the iron and concrete materials employed in the sewer system.

From the aforementioned it will be evident, that metal finishing plants could cause considerable damage to the common property with their indiscriminate waste discharge. It is the duty of the municipal sanitary engineers to guard against such abuse and a few thoughtless platers might ruin the existing goodwill for the whole local industry. With a minimum of equipment and just average care it ought to be possible to satisfy the stated requirements. Without this consideration on the other hand, it is very likely that the advantages inherent in these lower requirements might be lost altogether, complete treatment being required — regardless of the fact that the waste will pass through the municipal sewage treatment plant.

Discharging Into the City Sewer System

No concentrated waste should be discharged without proper treatment. Acid pickles, bright dips, stripping solutions, cleaners, etc. have to be neutralized, oil and grease scum removed and the precipitated salts settled. The settled sludge could be collected and dried on sludge beds or through filtration and priodically hauled away. In some cases it might even be permitted to slowly release the sludge with the running rinses, exercising caution that the quantities going down the sewer are small, so the chances for settling during the runoff are excluded. Any plating or processing solution which has to be dumped should be treated chemically, so that all toxic compounds are destroyed, the pH adjusted and the metallic salts precipitated.

It is wrong to believe that the contents of a 5 gal. crock may be dumped and treatment is required only for larger quantities. A chromic acid type bright dip if discarded, depending only on dilution to reduce the toxicity, would require a dilution factor of approximately 1 : 500,000. Since the chromic acid content of a chromium plating solution is at least twice as high, the dilution factor would have to be doubled also. It is evident from these figures, that dilution and dumping is not a satisfactory means for disposal. No doubt the most economical manner to operate is to avoid the necessity of dumping. Satisfactory means for purification and regeneration are available in many an instance where dumping is resorted to. The second most economical way of disposal is through treatment and the most expensive means is the one most often practiced: to open the valve and let the solution run down the sewer. This disposal method is fast and a minimum of labor and chemical costs are involved: but it may bring along a series of stringent restrictions for more than just the one plant involved in the sewer poisoning case.

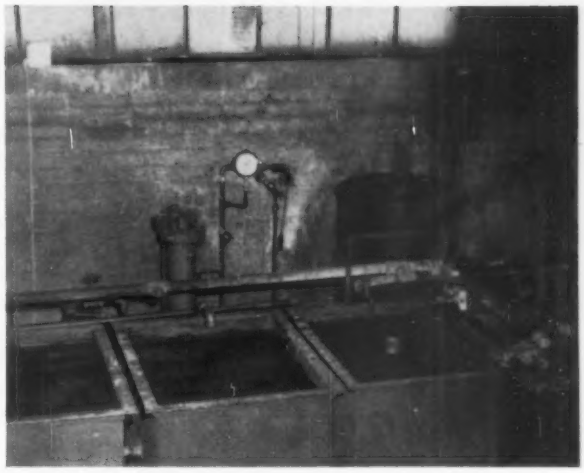


Figure 2. Rubber line barrel holding stock solution of sodium hypochlorite and chlorine feed system used after copper cyanide strike.

The rinse waters need cause no serious concern where the waste is treated by the municipal sewage treatment plant, though it is always rewarding to reduce the dragout by suitable arrangements well known in the plating trade and discussed in detail elsewhere.[1,2,3,4] To keep the dragout at a minimum becomes a must where the plating or process solution contains toxic compounds. It is the author's opinion, that none of these "normal" rinse waters could be of any harm to the operations of the sewage treatment plant but, by now, based on their earlier bad experience, quite a few localities have posted minimum standards. A few platers could always be found who would attempt to dump their faulty chromium plating solution with the rinse waters, thus our own educational program has to be finished before the arguments can be renewed with the sanitary engineers. The minimum requirements of the local authorities in conjunction with the actual analysis of the waste effluent will determine for the individual plant whether or not any treatment is required on the rinse waters.

In the event that treatment appears necessary, a simple conversion to cyanates might be sufficient for cyanide containing waste[5,6], while integrated treatment of chromic acid or copper containing rinse waters might be easily performed in a manner to be described later in this paper.

Discharging Into Natural Bodies of Water

Waste treatment involves the elimination of toxic compounds from the waste, low suspended solids and oil content and a near neutral pH.

It is evident that all concentrated waste has to be treated and settled before the clear supernatant liquid may be discharged. With the relatively small quantities of acids, alkalies and other concentrated process solutions usually discarded in electroplating operations, this problem is a minor one. A detailed discussion of neutralization methods in view of the training of a plater is not necessary. The batch treatment of toxic-compound-containing waste follows the same chemical pattern employed in the continuous treatment system described in connection with the "integrated waste treatment" method of rinsing.

The elimination of toxic waste from the plating rinse waters is the main problem, since pretty near all the waste waters discharged from an electroplating plant were employed for rinsing purposes.

Natural bodies of water are the source of drinking water for large communities and pollution upriver may make the purification for drinking water quite involved. Aquatic life has to be protected also. Fish are extremely sensitive to minute quantities of poisonous chemical compounds; thus the question of qualitative and quantitative toxicity is derived from biological experiments with different species of fish. The dilution factor with regard to the dry season flow of the receiving water body and also its importance as a source of game will have some effect on the requirements established by the sanitary authorities. Assuming a situation with tight standards, the treatment has to yield an effluent with less than 1 ppm (.001 g./l.) CN or CrO_3 radical, 1 ppm Cu, Cd and 5 ppm Zn, Pb ions.

The first step, when planning waste treatment, is usually a survey of the plating plant to decide which are the rinsing steps causing the contamination of the waters. Normally the rinse waters after pickling, acid dipping, cleaning, nickel, tin and acid zinc plating will not require treatment. The slight quantities of free acid or alkali from these processes are not harmful and the iron, nickel, tin and zinc salts are precipitated at a neutral pH thus, only settling might be required. The rinse waters after cyanide plating solutions, chromium plating, bright dipping, etc., on the other hand, will all require treatment.

Figure 3. Full automatic conduit tubing plating machine employing a zinc cyanide solution.

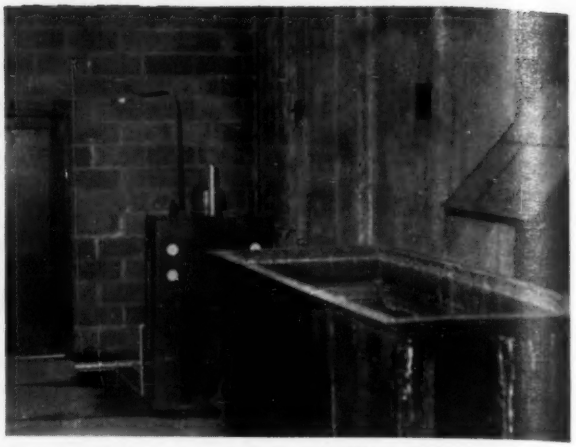


Figure 4. Chlorinator and treatment solution reservoir tank taking care of cyanide waste from plating unit shown in Figure 3.

It is important to have an idea of the approximate quantities of the toxic compounds which are discharged. After 4-5 hours of uninterrupted operation it may be assumed that an average reading can be taken. Measuring the flow rate and analyzing a sample of the rinse effluent will give an average value, which may be used for the initial calculation. Some practical means of finding average flow rates are:

1. Diverting the rinse water to a container of known capacity and timing the filling.
2. Partially emptying the rinse tank and checking the time required to reach the overflow; closing the overflow and reading the elapsed time until the water reaches the rim of the tank, etc.

The amount of dragout varies greatly with the shape of the article being plated, thus it is advisable to repeat the process of flow measurements and sample analysis 2-3 times to arrive at a fair average of toxic compound discharged per minute, hour, or day. The chemicals consumed in the treatment process will depend entirely on the quantity of dragout. At this point it is advisable to consider all the possible means at the platers disposal to reduce the dragout from the finishing process. Rechecking the quantities of toxic compounds wasted after the dragout reducing measures were taken, it should be easy to calculate the value of the savings in both processing and treatment chemicals in comparison to the increase in production costs due to these dragout saving steps.

For the treatment of toxic waste the author suggests the use of the "integrated waste treatment" system. (Pat. application pending.) Earlier publications[7,8] give a general description of this subject. The basic idea is to render the toxic compounds harmless by washing the work with a solution containing the chemical compounds needed for the treatment. This solution is not wasted, but kept in use for a considerable length of time or maybe permanently. The treatment chemicals are added either continuously or batchwise at the same rate as they are consumed by the toxic compounds receiving the treatment. Running rinses are employed only to wash the work free of the harmless dragout from the treatment solution. These rinse waters

then are considered acceptable waste by the sanitary authorities and no further treatment is required.

From the foregoing, it will be evident that an acceptable treatment solution should meet the following requirements:

(1) It shouldn't tarnish or discolor finished work.

(2) It shouldn't interfere with functional requirements such as corrosion resistance, paintability, activity of the surface insofar as subsequent deposition steps are concerned, etc.

(3) It should reduce the waste instantly, otherwise the treatment solution would contain low concentrations of the toxic compounds just as a rinse water would.

(4) It should, if possible, precipitate the treated waste so that this can be settled or filtered out or result in a gaseous breakdown product perpetuating the life of the treatment solution.

The main advantages of the integrated waste treatment may be summed up in the following:

(1) Only inexpensive equipment is required; also the equipment is similar to the type the metal finisher is familiar with.

(2) The treatment process is integrated into the finishing line, thus no separate treatment plant is necessary.

(3) Floor space requirements are negligible.

(4) Lower chemical consumption due to the fact that, in the conventional waste treatment, large quantities of rinse waters have to undergo different pH change treatments for efficient treatment and subsequent neutralization.

(5) Ease of control and supervision. The treatment solution used may contain an excess of treatment chemicals and, since the solution is not discarded, this does not mean a waste of chemicals. Close control is not necessary, but the supervision can be restricted to a check for this excess by using graduated test papers or drop tests.

(6) The chemical additions and supervision do not require separate personnel even in the largest installations. Continuous chemical feeders may be used and the tank man can perform the routine tests because the latitudes are so wide and the test methods so simple.

Figure 5. Plater dipping rack into cyanide treatment solution after copper plating.

Figure 6. SO_2 feed system showing gas bottles, pressure regulator, flow meter, and gas drying apparatus.

(7) Numerous improvements noticeable in the finishing process proper, due to the better rinsing after the waste treatment without the usual traces of dragged-out process chemicals.

(8) Waste waters free of the heavy chemical contamination usual with conventional treatment methods.

(9) Considerable reduction in the quantity of fresh water needed for rinsing.

(10) The sanitary authorities usually consider this type of toxic waste elimination "abatement" and not "waste treatment."

The term implies, that the industrial process, in this case electroplating, does not generate toxic wastes; the harmful compounds are kept out of the sewers and kept inside the industrial plant. The implication here is that formal application for approval of the treatment plant will not have to be submitted, samples of the treated batches will not have to be preserved, etc.

To some extent this list of advantages is superficial. It would be sufficient to stop at #1 and say that the installation cost is only 1-10% of the conventional treatment plant.

Due to space limitations and the inexhaustible subject, only two typical specific problems will be considered here namely, the wastes from cyanide copper and chromium plating. Other particular finishing processes will require a treatment step to suit the specific job, but the established pattern will be always the same.

Cyanide Copper Plating

The toxic compounds to be eliminated are the cyanide radical and the copper metal. Both should be reduced to zero as far as practical quantitative waste analysis is concerned.

Chlorination is an inexpensive and easily controlled treatment method described in great detail in previous publications.[9,10] Where waste treatment is prescribed, the cyanide usually has to be totally destroyed, cyanates are not accepted as harmless compounds in the waste. With sufficient chlorine to fulfill the requirement

of the reaction, the cyanide radical is broken up into carbon dioxide and nitrogen gases and most of the cuprous ion is oxidized to cupric oxide, while some copper is precipitated as the cuprous salt.

The treatment solution containing the free chlorine may be a mild steel rinse tank, which is in the plating line after the copper plating or dragout recovery steps. Since the usual rinse tanks contain only 50-500 gal. of solution, a larger 500-1000 gal. treatment solution reservoir is added to the layout for operating convenience. This storage tank may be located in any convenient spot in the plating shop and it is connected through a pump with the treatment rinse tank. The same storage tank may serve more than one treatment rinse, such as the rinse after the copper strike, brass plating, etc. The main purpose of the storage tank is to provide a larger quantity of treatment solution. The rate of dragout is never uniform in a plating installation, with a larger storage capacity the average dragout rate may be more easily anticipated.

The free chlorine may be added in the gas form through a chlorinator and diffuser. The use of gaseous chlorine is very convenient, the rate of flow may be easily adjusted and even with relatively large installations no corrosive chlorine gas escapes into the atmosphere. For smaller installations, where the cost of a chlorine dispenser cannot be justified, sodium or calcium hypochlorite may be used.

Simultaneously with the chlorine additions, the treatment solution make-up requires caustic soda additions to maintain a pH above 8.5, unless sodium hypochlorite solution is used as the chlorine source. Since it is very important that the high pH be maintained, it is advisable to standardize at a pH considerably higher, such as 10-11 to keep well above the dangerous limit. The caustic soda may be added batchwise or continuously through proportioning feeders in the liquid form.

The author has found the inclusion of a foam suppressing agent very beneficial. It will help to counteract the foaming tendencies of the wetting agent dragged in from the copper plating solution and increase the penetrating action of the treatment solution.

One of the most important advantages of the integrated waste treatment system is that the chemicals required for the treatment may be carried in considerable excess. To make control easy a test paper was developed which will indicate if the free chlorine is in the range of 2.5-5 ppm; 5-10 ppm; 10-30 ppm or higher range. A chlorine color comparator similar to the well known pH comparator set is also available. All that is required from the operator is to test the solution 2-3 times a day, increase the rate of chlorine flow whenever the chlorine content gravitates to the low range, and decrease the flow when the excess is mounting. A 20-50 ppm excess is standard. Standard instruments are available for fully automatic control.

The high chlorine excess has some further advantages:

(1) The oxidation of the cyanate is accelerated.

(2) The copper complex is rapidly decomposed and the copper precipitated in the black cupric oxide form. The cupric oxide settles very rapidly and there is less chance for the dragout of copper salts.

(3) Sufficient free chlorine is left in the system during shut down periods to completely convert the cyanate to the gaseous breakdown products. A free chlorine test of 2.5-5 ppm should show after a weekend or overnight shut down. A pH paper test should be taken at the same time with the chlorine test, to make sure the pH is within the prescribed limits.

The treatment solution may be used for a long period of time. Slowly though, the dissolved and non toxic salts such as NaCl, Na_2CO_3 etc., build up and increase the viscosity. On the average, after 2-3 months, it will be found that dumping of the treatment solution would be advantageous. Before dumping, the treatment solution should be allowed to rest for at least eight hours to assure the complete conversion of the cyanates. After a quantitative determination, the free chlorine and the pH may be reduced, the sludge settled over a week-end. The clear supernatant liquid may be dumped now and the sludge discarded on drying beds or hauled away. In larger installations, it will be found advisable to have a separate holding tank for the waste treatment solution to be dumped. This will give time for analysis, reduction of the free chlorine and pH, settling, etc.

Filter bags and filter parts should be well washed first in the treatment solution before rinsing with water. Due to relatively high cyanide drag-in with the filtering sludge and filter bags, the available free chlorine may be quickly exhausted. It is advisable to check for free chlorine with the test papers more frequently during the cleaning of the filter parts and allow some time for this operation.

It is always possible that the steam coils or heat exchanger used for heating the cyanide copper plating solution develop a leak. This might cause a serious waste contamination if it is not detected at once. A conductivity bridge connected to an electrical warning signal eliminates this hazard.

Chromium Plating

The toxic compound to be eliminated is the chromium. Usual requirements stipulate a chromium concentration of less than 1 ppm in the waste.

Among the possible treatment methods, one which consists of the reduction of the hexavalent chromium and precipitation of the chromic hydroxide appears most economical and is well suited for the integrated waste treatment system. An economical and very easily handled reducing agent is sulphur dioxide gas. It has the advantage that the rate of addition is controlled by a single valve, the gas being delivered from the liquid SO_2 container into the treatment solution under its own pressure with a flowmeter indicating the constant rate of flow. A minimum of handling equipment is thus required, with simple controls. For larger installations even automatic means of control are quite feasible and simple.[11,12]

The reduction of the chromic acid probably follows the reaction:

1. $SO_2 + H_2O = H_2SO_3$.
2. $2H_2CrO_4 + 3H_2SO_3 = Cr_2(SO_4)_3 + 5H_2O$.

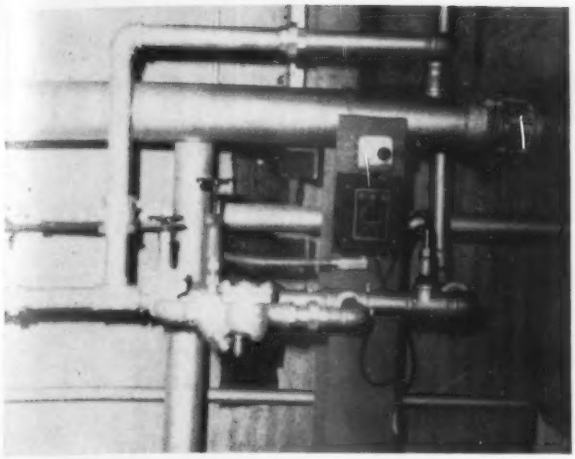


Figure 7. Conductivity bridge and cell alarm system guarding against plating solution contamination from heat exchanger.

The excess sulphur dioxide converting into sulphurous acid will tend to reduce the pH. It is advisable to standardize at below pH 3 since the reduction of the hexavalent chromium is pretty nearly instantaneous at this low value.

The precipitation of the chromic sulphate may be easily accomplished with alkali additions to reach a neutral pH.

3. $Cr_2(SO_4)_3 + 3Ca(OH)_2 = 2Cr(OH)_3 + 3CaSO_4$.

The reduction of the chromic acid and the precipitation of the chromic hydroxide may be accomplished in one treatment step by suitable mechanical arrangements. Using a treatment solution reservoir connected through pumping with the treatment wash, it is possible to maintain a low pH at the point where the SO_2 gas is added, at the same time a neutral pH may be maintained in the reservoir; itself thru the additions of alkali.

Where the facilities allow it, especially in automatic plating units, a simpler two step process is possible with two treatment wash tanks. The first treatment would act as a reducing step and the second treatment serve as the neutralization and precipitation station. The inclusion of a suitable wetting agent in the treatment solution makeup is advised.

Automatic control instrumentation is easily used in this setup but, due to the large variation allowable in treatment solution composition and the simple control developed for the tank man, extensive instrumentation is not necessarily economical. Automatic pH and potential meters, servo and electronic relays are simple and relatively inexpensive instruments, but will fit into operations only if the plant personnel are familiar with the operation and maintenance of these instruments. The simplicity in design of a treatment plant has to be carried to the extent that there is no need for the services of a chemist, electronics engineer or instrument maintenance man to control the satisfactory operations of the set up. To achieve this aim, all control steps are reduced to test paper, spot test or other approximations. A rough estimation of the excess of treatment chemicals is always sufficient for control purposes.

With proper settling and sludge removal or filtering facilities, the treatment solution may be kept in operation indefinitely. The sludge itself consists of relatively pure chromic hydroxide and may be sold as a waste by-product.

The integration of the chromic acid waste treatment into the plating line has two very important beneficial effects on the plating operation:

1. Proper rinsing and drying after chromium plating is made possible. As the chromic acid is reduced in the waste treatment steps, the yellow staining of the work due to chromic acid oozing out of recesses, threaded holes, and from behind the rack springs, is eliminated.
2. The work holding rack, if used for cleaning, copper, or nickel plating, is a constant source of chromic acid contamination for these process solutions. With the integrated waste treatment the chromic acid carried by the rack is also rendered harmless for these chromic-acid-sensitive process solutions.

Chromic acid contamination of the waste waters may also be caused by condensation in the exhaust duct system, faulty steam coils, etc. All these possible sources of leaks have to be considered if the waste treatment layout is expected to be successful.

Collected steam condensate from the duct system may be discharged into the treatment solution. Also, anodes may be washed here. Naturally the rate of chemical additions would have to be temporarily increased while these larger additions of chromic acid are made.

References

1. F. R. Keller, C. C. Cupps & R. E. Shaw. Plating, **39**, 152 (1952).
2. J. B. Kushner. Metal Finishing, **48**, 75 (May 1950).
3. J. B. Kushner. Metal Finishing, **49**, 59 (Nov. 1951).
4. R. J. Rominski & F. L. Clifton. AES Proceed., 38 (1951).
5. C. F. Hauri. Plating, **38**, 240 (1951).
6. N. S. Chamberlin. Metal Finishing, **49**, 54 (Aug. 1951).
7. L. E. Lancy. Metal Finishing, **49**, 26 (Feb. 1951).
8. L. E. Lancy & H. F. Hanson. Plating, **39**, 210 (1952).
9. J. G. Dobson. Metal Finishing, **45**, 78 (Feb. 1947); 68 (Mar. 1947).
10. A.E.S. Research Project #10 Reports. Plating, **36**, **37**, **38**, **39** (1949-1952).
11. J. L. Kelch & A. K. Graham. Plating, **36**, 1028 (1949).
12. C. M. Gard, C. A. Snavely& D. J. Lemon. Sewage Works J., **23**, 1429 (1951).

Electroless Nickel Plating on Non-Ferrous Metals

By Harry J. West, *Chemical Engineer, Goshen, Indiana*

PREVIOUS articles on electroless nickel have dealt with the plating of steel. The present one will discuss the process of plating directly on aluminum, brass, copper and titanium. This process also is producing excellent results on most stainless steels.

The previous articles dealt with the acid type solution, which is not suitable with the abovementioned metals and alloys. An alkaline type electroless nickel is used instead.

The formula which follows must be compounded accurately and pure chemicals should be used. The formula is for a ten gallon make up and may be increased proportionally for any larger volume.

Sodium citrate	6 lb.
Ammonium chloride	4 lb.
Nickel chloride	2½ lb.
Sodium hypophosphite	10 oz,
Ammonium hydroxide	500 cc.
Water	10 gal.

A pH of approximately 10 must be maintained and the continuous additions of ammonium hydroxide are necessary to maintain proper pH and secure desired results. We have found that an additional 500 cc. of NH_4OH is required about every second tank or pot load equivalent to about 30 sq. ft. of plated surface area. This is for either racked parts or barrel parts. The same conditions exist here as with the acid type solutions described in the previous articles, such as tank or pot linings which must be of glass or its equivalent. A porcelain lined tank is being used at the present time with excellent results. Racks must not be coated with any organic coating, plain steel racks are best. The high temperature Lucite barrels have proved satisfactory in barrel plating. The temperature must be maintained at between 180-190°F., preferably 180°F. for barrel. A carbon coil is being used for heat supply. Although it takes a deposit of nickel, the coil can be stripped with 50% nitric acid without injury to coil or tank lining.

Parts are cleaned and processed exactly as in ordinary electroplating. Aluminum, however, should be placed in the plating solution immediately after cleaning or allowed to remain under cold water until ready to be plated. Titanium reacts the same way and some amalgamation may be present so that the plated coating would consist of nickel, phosphorus and titanium. Brass, copper and copper alloys coat effectively and no trouble is usually encountered.

A very violent reaction takes place during the actual plating and, as the reaction decreases, the pH goes down and addition of NH_4OH is necessary.

The deposit thickness is quite appreciable. We have obtained 0.001″ nickel plate on 2S aluminum in 30 minutes. However, this will vary as the solution changes during use and the above figure was for a new solution. However, only very slight change in thickness will result if the solution is properly maintained.

The solution, unlike the acid type, need not be thrown away at the end of each day or after a certain amount of use. The same solution may be used continuously with addition of chemicals, as shown in the original make up. It has been found that, after a full day's production of 8 hours, the nickel chloride must be replaced and at the end of 16 hours of continuous operation, all chemicals must be replaced or the original amount of makeup added to solution.

A very small amount of aluminum sulfate (about 1/100 oz.), if added just before plating each batch of aluminum, is beneficial but is eliminated when coating copper and its alloys.

This particular type of electroless nickel works very well with most stainless steels and no blisters will show if a good job of cleaning is done.

Deposition on the walls of the plating tank or pot is very noticeable and the nickel must be removed periodically; 50% nitric acid does a very nice job.

Small parts such as screws, nuts, etc. can be basket plated in this solution, also with excellent results. The basket is removed from the pot and shaken several times during the plating operation. Laminated nickel deposits are not obtained as a result of this interruption. The parts of aluminum, brass, or copper may be removed from the solution for inspection at any time during actual plating without affecting the deposit.

Government Finishing Specifications

An Explanation and Digest Relating to Metal Coatings and Surface Treatments (Other than Organic Coatings)

By N. E. Promisel, *Navy Department Bureau of Aeronautics and* David M. Promisel

ADDITIONAL GOVERNMENT SPECIFICATIONS

The following specifications were inadvertently omitted from the first installment of the article, "Government Finishing Specifications," which appeared in our May issue.

MIL-M-10578A — Metal Conditioner and Rust Remover (Phosphoric Acid Base)

(Supersedes Army Spec. 3-213, 3 August 1953)

When diluted with water and applied to metal surfaces, will remove rust from ferrous metal surfaces and provide a slight etching action for ferrous and non-ferrous metals to promote adhesion of paint or corrosion preventives.

Type I: Wash-off (non-inhibited).
Type II: Wipe-off (non-inhibited).
Type III: Inhibited.

Composition — Shall be phosphoric acid base, clear liquid, not required to conform to definite chemical composition requirements except as specified later in specification.

Concentration — To be diluted for use as follows:

Type I and II: 3 parts water to 1 part conditioner.
Type III: 2 parts water to 1 part conditioner.

Homogeneity — Shall form homogeneous solution without apparent separation when diluted as above.

Sedimentation — Shall show no sediment or sludge formation after standing 24 hours.

Flash point — Not less than 135°F. (Tag closed up).

Acid content —

(1) No mineral acids (except phosphoric) or their salts.

(2) Phosphoric acid content. Type I, undiluted, shall contain not less than 68% free orthophosphoric acid (grams of acid per 100 ml. compound); Type II, undiluted, shall contain between 20 and 25% free orthophosphoric acid on same basis as above; Type III, undiluted, shall contain not less than 42% free orthophosphoric acid on same basis as above.

Organic Solvent (Applicable only to Types I and II)

Type I, undiluted, shall contain not less than 16% by volume of water soluble organic grease solvent when tested as per specification.

Type II, undiluted, shall contain not less than 25% by volume of water soluble organic grease solvent when tested as per specification.

PERFORMANCE:

(1) Shall be at least as good as comparison formulae given below in removing films of MIL-G-10924 grease from 1020 cold-rolled steel under prescribed conditions.

(2) Shall produce not more than slight etch when allowed to remain in contact with iron, galvanized iron, brass or aluminum at a temperature of 25° ± 5°C.

Toxicity — Shall not contain toxic substances, shall not give off injurious fumes or vapors and shall not contain more than 5 parts per million of arsenic.

Application — Diluted conditioner shall be capable of leaving treated metal clean of rust, stickiness and gumminess when applied as follows:

Type I — By spray, immersion or flow brush.
Type II — By rag, sponge or preferably brush.
Type III — By spray, immersion or flow brush.

STANDARD COMPARISON FORMULAE:

TYPE I

Material	*Parts by volume*
Phosphoric acid (85-per cent), ml.	118.0
Triton X-100, Igepal CA-630 or Atlas G-1690, ml.	5.0
Butyl cellosolve, ml. (Ethylene glycol monobutyl ether)	40.0
Water, sufficient to bring total volume in ml. to	250.0

TYPE II

Material	*Parts by volume*
Phosphoric acid (85-per cent), ml.	35.0
Triton X-100, Igepal CA-630 or Atlas G-1690, ml.	5.0
Ethylene glycol monobutyl ether (butyl cellosolve)	62.5
Water, sufficient to bring total volume in ml. to	250.0

TYPE III

Material	*Parts*
Phosphoric acid	23.8 lbs. (1.7 gals.)
Diethyl thiourea	1.34 ounces
Nacconol NRSF	5.0 ounces
Water	8.3 gallons

Shop Problems

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Tin Plating Strip

Question: We are a regular subscriber to your esteemed publications and our chief product is cold rolled steel strip and electro-tin coated steel strip. We shall be much obliged if you could kindly inform us the composition of electro-tin plating solution used in the United States, which contains $SnSO_4$ as a chief composite. Further, we should like to know the method of the chemical treatment of chromate solution and its composition after the strip is tin-coated.

Y. M.

Answer: A standard acid tin sulfate solution contains the following:

Stannous sulfate	13 oz./gal.
Sulfuric acid	4 "
Tartaric acid	4 "
Animal glue	0.4-0.8 oz/gal.
Betanaphthol or cresol	0.13 oz./gal.

The chromate treatment for tinplate consists of the following:

Anhydrous trisodium phosphate	1.2 oz./gal.
Sodium dichromate	1.1 "
Caustic soda	2.7 "
Wetting agent	0.4 "

Treatment is 30 seconds at 185 deg. F., followed by rinsing.

The wetting agent should be stable at high pH and in the presence of chromates.

Hard Facing Alloy

Question: We have been advised of a new coating known as "Colmanoy." All we know is that it is supposed to be 15 to 20 times harder than hard chrome and that it originates in Detroit. Could you please help us locate the firm marketing this process?

F. J. K.

Answer: "Colmonoy" is a hard facing alloy used for pump and valve parts and contains nickel, chromium and boron. It is marketed by Wall-Colmonoy Corp., Detroit, Mich.

Black on High Nickel Alloy

Question: I have a problem to which I would appreciate an answer or suggestion. It is desired to produce a uniform black surface (either glossy or dull) on an alloy containing approximately 60% nickel and 30% copper. The surface coating should withstand mild abrasion from handling and should contain nothing which will cause a gassy condition in vacuum tubes.

E. S. B.

Answer: You might try heating in an oxidizing atmosphere for a few minutes at 1550-2200 deg. F. to produce an oxide film which has a good black appearance. This process was patented by The International Nickel Co., Inc.

If an oxide film is unsuitable, a suitable finish may be obtained by using the platinum black process, such as is employed for electrodes. The procedure will be found in most chemical handbooks and text books on experimental electrochemistry.

HAE Process

Question: Please send us whatever information you have available on the "HAE" magnesium surface treatment process and on the names and locations of firms who are equipped to apply this surface treatment.

R. M. G.

Answer: The process consists of treatment with alternating current at up to 100 volts and 15 amp./sq. ft., at a temperature of 75-85°F. in a solution containing potassium hydroxide, aluminum hydroxide, trisodium phosphate, potassium fluoride and potassium manganate. The finish is a good paint base and is considered more abrasion resistant than the Dow No. 17 treatment. We would suggest that you communicate with the Dow Chemical Co., Magnesium Dept., Midland, Mich. for further details.

References Explained

Question: In your article, "Technical Developments of 1953," your bibliography lists several that I would like very much to read. They are No. 109 (structural features of porous types of anodic coatings), No. 113 (plating magnesium), No. 117 (plating titanium). Would you be so kind as to explain your bibliography system (the meanings of the numbers in bold print, normal print, etc.) and also tell me where to obtain copies of bulletins of The Electrochemical Society and of the magazine Metal Industry?

W. S. E.

Answer: The biblography system used in METAL FINISHING is a standard presentation. The bold face number is the volume number, the next number is the first page on which the article appears, and the date in parentheses is the date of publication, in this case all the references being 1953 so that only the month and day are given.

Copies of articles published in the Journal of The Electrochemical Society may be obtained from the Society at 216 W. 102nd St., New York 25, N. Y.

Metal Industry is a British publication and may be reached at 9 Charlotte St., Birmingham 3, England.

Brush Chromium Plating

Question: We would appreciate receiving from you the name and address of a supplier of a brush plating unit for chrome.

J. N.

Answer: A process called "Dalic" is supplied by Metachemical Processes,

Ltd., 13 Strafford Road, London, W. 3, England.

Contrasting Black on Silver

Question: Please give us information on the methods available for blackening silver so as to give the maximum contrast between the relieved silver highlight and blackened recesses. Brief experiments with ammoniacal polysulfides have not been satisfactory due to a lack of sufficient contrast.

L. E. C.

Answer: Since a black nickel electrodeposit is darker than the sulfide coating, we would suggest the former method to obtain greater contrast on your silver.

Chromium Plating Stainless Steel

Question: We manufacture fishing pole tops and guides and use stainless parts and we have some trouble in getting these parts fully chromed. After we get these stainless parts polished and ready to chrome, is there any solution they can be dipped in to make the chrome cover them completely?

S. H. K.

Answer: The use of a nickel chloride strike prior to chromium plating will probably improve the coverage. The solution consists of:

Nickel chloride ..... 2 lbs./gal.
Muriatic acid ..... 1 pint/gal.

Direct current at 6 volts, room temperature, for about ½ to 1 minute. Use nickel or carbon anodes.

Plating Tungsten and Rare Metals

Question: I would like to know if there are any formulas for plating lanthanum, cerium, thorium, and tungsten. I have looked through your recent guidebooks and monthly publications, and have been unable to find any formulas on the above.

H. A. H.

Answer: Tungsten alloys are the only ones which have been deposited commercially, but experimental work has been done on lanthanum and thorium. We know of no studies of the deposition of cerium.

Surveys of the above metals and their electrodeposition will be found in the book "Modern Electroplating," sponsored by The Electrochemical Society.

Formulas for depositing tungsten alloys will be found in this book and also in "Principles of Electroplating" by Blum and Hogaboom.

Scale Removal from Stainless Steel

Question: I have run into difficulty in stripping oxide scale from stainless steel weld bolts which are welded to commercial grade steels. I have tried sand blasting with aluminum oxide grit. I have also tried a combination of acids for removing oxide from stainless steel but it etches the steel badly. I would appreciate it if you could in any way help me.

J. H.

Answer: Most acids used for pickling scale from stainless steel will etch carbon steel. However, if you loosen the scale by immersion in hot sulfuric acid, you can minimize the etching by using an inhibitor in the acid. Most plating supply houses sell these inhibitors, but a list of manufacturers will be found on page 533 of the 1954 edition of the *Metal Finishing Guidebook-Directory*.

Determining Correct Anode Area

Question: We are using small tanks of the potassium stannate and cadmium solutions given in the Metal Finishing Guidebook. Since our parts are very tiny we are unable to calculate the surface area. How can we be sure that the anode areas are correct?

J. E.T.

Answer: The amount of tin anode surface in the stannate bath can be controlled visually. The surface should have an iridescent greenish-yellow film. If the film is black it indicates too high a current density and, if it is a clean white, it would indicate too low a current density. This, of course, presumes that the caustic content of the solution is correct.

The cadmium anode surface should be sufficient to prevent polarization. This would be indicated by a rise in voltage. A larger surface than necessary will not be harmful.

ABSTRACTS

The Triangular Cell for Rapid Control of Electrolytes for Plating

E. Bertorelle; *Metalloberflaeche*, vol. 6, No. 1, pp. B2 to B5.

The cell consists of a small triangular tank of Plexiglass or similar material with a side length of 172 mm and a wall height of 60 mm. The anode which is 3 mm. thick, 60 mm. wide and 80 mm. high is fastened to one of the three walls and suitable current contact is ensured by means of clamps. The anode is fastened between a tank corner and a Plexiglass support fastened on the tank wall; and this has the function of preventing the current effect on the anode edge not protected by the tank corner. The cathode is arranged at the tank corner opposite the wall along which the anode is fixed and the cathode is further arranged so as to be vertical (normal) to the anode. The cathode is a perfectly flat small plate and reaches from its respective tank corner to a small rod placed in the middle of the tank. This rod has the double function of mechanical support holder and a current screen, and is 5 mm. in diameter and 60 mm. high. The cathode plate has a thickness of 0.1 to 0.2 mm, a length of 100 mm. and a height of usually 70 to 80 mm. so that it projects above the electrolyte surface and allows the clamp to be fastened for the current contact.

For a test operation, the tank is filled with 500 cc. of the electrolyte to be tested (the liquid height including the electrodes rises 50 mm. from the tank bottom) and connected to the electrical circuit which includes a source of direct current, an ammeter and a variable resistance. With the Hull cell, for exact measurement, any deposit on the back of the cathode must be prevented by lacquer or other means and, in addition, it is very difficult to prevent the current concentration effect at the edge of the cathode in the neighborhood of the anode. With the triangular cell, this difficulty is eliminated, as both sides of the cathode are plated and the edges of the cathode are screened. Details for standardizing the cell and obtaining the standard plating curve of reference are given. A special application of the cell in practice is the determina-

tion of the current density values with which effects are obtained which are to be ascribed to organic substances or inorganic impurities. The field of investigation here is considered great and it is intended to conduct considerable research in this direction with this cell.

Preparation of Articles for Gold Plating

A. Darlay: *Galvano* (Paris) vol. 22, No. 198, p. 11.

As with all electroplating operations, the preparation of the metal surface plays an essential role. The final appearance of the gold plate will depend on the degrees of polish and the adhesion will be a function of the primary cleaning which is so often neglected in gold plating with consequent indifferent results. It is a complete fallacy to consider that the warm cyanide baths which are used will exert a sufficiently moderate cleaning action and that the thin coatings which are normally applied in gold plating will not evince any exfoliation. This reasoning can hold if only a gold flash is being applied but it is extremely dangerous when heavier gold plates are being applied and particularly an electroplated gold finish.

For copper and nickel base alloys the following series of pretreatment operations prior to gold plating should be practiced:

a) Immersion in a warm alkaline cleaner which favors the saponification and emulsification of the oils and greases as well as the elimination of the abrasive residues whch can remain in the hollow parts of certain pieces of complicated shape. This degreasing bath can have the following composition:

Sodium carbonate	30-40 g./l.
Trisodium phosphate	30-40 "
Wetting agent	3-4 "

Temperature: 60-70° C. Time: 30 seconds to 1 minute.

b) Rinsing in running water or under pressure jet.

c) Electrolytic cleaning in a cold cyanide bath of the following composition:

Caustic soda	50 g./l.
Sodium carbonate	40 "
Sodium sulfate	15 "
Sodium cyanide	10 "
Wetting agent	0.25 "

The bath is worked at room temperature with a current density of 6-10

amp./sq. dm. at 6-8 volts and treatment time is 30 seconds to 1 minute.

d) Rinsing in running water.

e) Immersion in a tank containing distilled water and which should be frequently renewed. The ware is then ready to be passed to the gold plating tanks.

It may be considered that the above sequence of operations is a little laborious but it results in assurance of obtaining a satisfactory coating at the gold plating stage. In certain cases it can be modified and the user is the best judge of this, dependent upon the diversity of the parts being treated and the nature of the metal being covered. It should be emphasized that, because of their low content of free cyanide and alkaline salts, the gold plating baths with a pH of 8.5 require scrupulously clean surfaces for proper operation and, in view of the expensive nature of gold plating, it is futile to seek to achieve an illusory economy in reducing the cleaning operations prior to gold plating.

Research on Chemical Polishing of Brass and German Silver

Paper read by H. Spaehn to the meeting of the Forschungsgesellschaft Blechverarbeitung (German Sheet Finishing Research Association) held at Wiesbaden, February 1953.

The process employed has been described in previous publications (Mitt. der Forschungsges. Blechverarbeit.) 1952, pp. 93-97 and pp. pp. 195-199 but amplified details were given in the paper read by the author. When the metal parts being treated are passed into the bright dipping bath, there is a potential difference between the parts and the acid, by which material is removed at the edges of the micro-roughness peaks. Accordingly, because a certain "Covering Coating" is deposited in the valleys of the surface roughness, these parts of the surface are protected from metal removal during the treatment. In this manner the surface micro-roughnesses are removed and this imparts a definite brilliancy to the surface which differs from that of mechanically polished metal surfaces. The treatment time is about 2 minutes.

The brightening capacity of the brightening baths is gradually lost as a result of the chemical reactions taking place with progressive use of the bath, while the water content of the bath increases as a result of the acid decomposition. To maintain this composition correctly within the permissible range it is necessary to maintain the effectiveness of the bath by regeneration. The author gave practical examples of application. This brightening process can now be applied on a large scale for brass and German silver.

Structure and Properties of Electroplated Alloy Deposits

E. Raub: *Metalloberflaeche*, vol. 7, No. 2, pp. A21-A24.

The structure of electrodeposited alloy coatings is of special practical interest for determining the physical characteristics of the coatings. With the electrolytic crystallization of the alloys from aqueous solutions it can, as with crystallization from the molten metal, lead to separate crystallization of the two components or to the formation of mixed crystals and intermediate phases. Considerable differences can exist in the composition of the individual phases as compared with the equilibrium diagram. Of importance is the presence or absence respectively of mixed crystals between the two deposited metals independent of the form of the constitutional diagram. Considering the lattice constants of electrodeposited copper alloys it is found that bismuth has no marked influence on the lattice constants of the copper. Both metals crystallize side by side without preceptible mixed crystals in the same way as when crystallizing from molten metals. Zinc widens the copper lattice increasingly with in-

creased zinc content. The saturation limit of the electrodeposited copper-rich mixed crystals lies practically the same as with the saturation limit of the recrystallized alloys. According to the constitutional diagram, lead is practically insoluble in copper. In electro-deposited copper-lead alloys, the copper lattice is, on the the other hand, widened until 12% lead can be contained in the mixed crystals. Also, with the copper-antimony alloys, the lattice constants show a saturation limit of the electrodeposited copper mixed crystals which lies above the recrystallized alloys.

Similar relations have been observed with the electrodeposited silver alloys. Curves showing the change of the lattice constants of silver by electrolytic crystallization with different metals, show the marked influence and the strong deviations of the lattice constants with the silver-cadmium alloys. No clear widening of the silver lattice is to be observed; but a lattice widening with normal mixed crystal formation can be established. In the last case it always concerns alloys which have been produced from electrolytes of a certain composition, containing additions which specifically influence the cadmium deposition. Lead and bismuth are normally only slightly soluble in silver; the saturation limit is below 0.1% for lead and bismuth respectively. With electro-deposition however, it is possible to include greater amounts of these metals with normal lattice widening of the silver, as mixed crystals. With lead it is possible even to exceed twice the maximum saturation of 5.2% according to the constitutional diagram.

This widening of the lattice by the formation of mixed crystals with electroplated alloys also changes the other properties. The specific resistance shows the rise which would be normally expected from the mixed crystal formation. The hardness on the other hand, behaves differently. It is, to a considerable extent, independent of the concentration of the dissolved metal. With various metals, the hardness of the electroplated mixed crystal alloys reaches a maximum value, independent of the nature of the dissolved metal, below which it fluctuates within a narrower or wider range. With electroplated mixed crystals of silver the upper limit is located at about 190 Vickers. With copper mixed crystals it is approximately 300. Approximately the same values can be reached with gold. With nickel alloying the maximum hardness is about 700 and with that of iron 800 to 900 Vickers.

PATENTS

Buffing Wheel

U. S. Patent 2,660,841. *Dec.* 1, 1953. *J. F. Leslie*

A buffing member adapted for detachable connection with a rigid center mount, comprising a fabric unit formed of a plurality of superimposed layers of cloth, an attachment member secured to the central portion of said unit, said unit being folded to skirt form, and a fabric insert secured within said skirt and cooperating therewith to render said skirt unit of substantially uniform thickness throughout.

Hot Dipping

U. S. Patent 2,660,979. *Dec.* 1, 1953. *M. E. Bills, assignor to U. S. Steel Corporation*

In a continuous metal coating apparatus including a tank for containing molten coating metal, a coating roll rotatably mounted in said tank, and driving means disposed adjacent said tank for rotating said roll, the improvement therewith of a flexible connection between said driving means and said roll, said flexible connection comprising a shaft projecting axially from one end of said roll, the outer end of said

shaft being counterbored, said shaft having a longitudinal slot in the inner side wall of its counterbore, a spindle pivotally attached at one end to said driving means, a ball on the opposite end of said spindle integral therewith, a pin projecting from the surface of said ball normal to the longitudinal axis of said spindle, said ball being fitted snugly in the counterbored end of said shaft with said pin fitted in said slot.

Rust Inhibiting Composition

U. S. Patent 2,661,296. *Dec.* 1, 1953. *K. F. Schiermeier and H. A. Poitz, assignors to Shell Development Co.*

A rust inhibiting composition of matter consisting essentially of from about 15 to 35% of a petroleum wax, from about 10 to 25% of lead salt of naphthenic acid and the balance being an aromatic solvent.

Strip Pickling

U. S. Patent 2,661,009. *Dec.* 1, 1953. *T. Dunnegan, Jr. and H. M. Ogle, assignors to General Electric Co.*

In apparatus for pickling steel strip, including a pickling tank, means to draw strip from the tank, and means including a variable-speed D.-C. motor to feed strip into the tank, an improved control system comprising a booster generator electrically connected in series with the D.-C. motor and having a field winding adapted for external excitation, a two-legged saturable magnetic element embedded in the floor of the pickling tank, a first winding around both legs of said element, connections, for energizing the first winding with an adjustable value of direct current, second and third windings around respective ones of the two legs, rectifiers connected in series with the second and third windings respectively, connections to apply two alternating voltages in phase opposition across the respective sets of series-connected rectifiers and windings, a magnetic amplifier having a signal winding connected in series with both sets of series-connected rectifiers and windings, the depth of immersion of the strip controlling the values of the currents flowing in said sets and the voltage supplied to said signal winding amplidyne having a field winding connected across the output of the magnetic amplifier and having its output connected to the field winding of said booster generator.

Flow-Brightening Tinplate

U. S. Patent 2,661,328. *Dec.* 1, 1953. *E. J. Smith, assignor to National Steel Corporation*

In the process of treating electrolytic tinplate strip in which the tinplate is passed through a flow-brightening zone and the tin coating melted, the steps comprising, passing the strip from the flow-brightening zone and precooling the molten tin coating in a gaseous atmosphere without effecting solidification of the tin coating, and then passing the precooled strip through a bath of quench water having a temperature not above 135° F. and solidifying the tin coating in the quench bath.

Method of Electropolishing Sterling Silver

U. S. Patent 2,661,330. *Dec.* 1, 1953. *F. Sullivan, assignor to Arthur D. Little, Inc.*

A method for the anodic polishing of silver-copper alloys containing at least 90% silver in an electrolytic cell containing a cyanide bath, which comprises the steps of applying electric current and potential difference between such silver-copper alloy as the anode surface, and the cathode of the cell, and of imposing a cycle of movement of the anode in and out of the cyanide bath at a rate equal to at least 10 cycles per minute, said potential difference between such alloy as the anode surface, and the cathode of the cell during the period of immersion

being below that which will form permanent discoloration and above that which will form etching, until the silver alloy acquires a polish thereon, said cyanide bath containing at least 0.35 mol of free cyanide.

Hot Galvanizing Conveyor

U. S. Patent 2,661,717. *Dec.* 8, 1953. *E. M. Wilson, assignor to Henry Hope & Sons Ltd.*

Conveying means for articles to be treated in a galvanizing bath, comprising in combination a mechanism for lowering and raising the articles into and from the bath, carrying means for the articles, said carrying means being movably attached to said mechanism for reciprocatory motion relatively thereto, a pair of spring-supporting abutments provided on said mechanism and carrying means respectively, a spring arranged between and supported at its ends by said abutments so that said spring is energizable by vertical movements of said carrying means in one direction relatively to said mechanism, and power-operated means connected to said mechanism and arranged to act on said carrying means for co-operating with said spring to effect intermittent vertical reciprocatory motion of said carrying means relatively to said mechanism, and thereby impart a jogging motion to articles on said carrying means.

Method of Impregnating an Oxide Coating on Aluminum and Resulting Article

U. S. Patent 2,662,034. *Dec.* 8, 1953. *R. B. Mason and W. C. Cochran, assignors to Aluminum Co. of America*

A method of impregnating an adsorbent artiefiially formed oxide coating on aluminum with resin, which consists in exposing the oxide coating to the vapors of at least one ordinary organocarbon substance providing monomeric synthetic resin forming reactants, in a closed container, at a temperature of at least about 200° F., whereby the vapors are adsorbed by the coating and therein polymerized to a resin.

Method of Electrodepositing Chromium Directly on Aluminum

U. S. Patent 2,662,054. *Dec.* 8, 1953. *F. Passal, assignor to United Chromium, Inc.*

A method of electrodepositing chromium directly on aluminum, consisting essentially of immersing an aluminum article to be electroplated for about 10 to 15 seconds in an aqueous alkaline zincate cuprocyanide solution to form a zinc-copper immersion coating thereon, removing said article and immersing the same in a nitric acid solution to remove said zinc-copper immersion coating, immersing the article in a second time for not more than 15 seconds in the aqueous alkaline zincate cuprocyanide solution to form another zinc-copper immersion coating thereon, removing the article from the latter solution, then immersing said coated article in a chromic acid chomium plating bath to completely strip the zinc-copper immersion coating and within 15 second passing electric current to said immersed stripped aluminum article as a cathode to electrodeposit chromium thereon, thus producing a chromium plated aluminum article having no intermediate coating between the chromium and the aluminum.

Volatile Corrosion Inhibitor

U. S. Patent 2,662,808. *Dec.* 15, 1953. *W. W. Newschwander, assignor to Shell Development Co.*

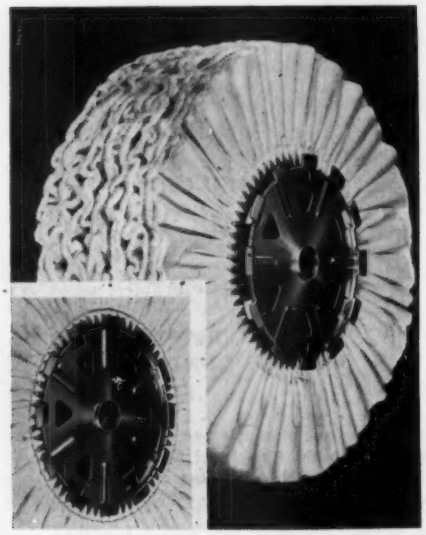
A substantially solid sheet packaging material containing a compound selected from the group consisting of isomeric nitrobenzaldehydes and the lower alkyl derivatives thereof in an amount of between about 0.01 gram and about 5 grams per square foot of said substantially solid sheet packaging material.

Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

Ventilated Buff

McAleer Buff Company, Dept. MF, 101 S. Waterman Ave., Detroit 17, Mich.



After many months of production testing in the Detroit and Michigan area, the company is now making available on a national distribution basis a new type ventilated buff called "Whirlwind." Specifically designed for high speed production cut and coloring operations, the buff is available with interchangeable centers and variable arbor hole sizes. This feature alone, permits savings of up to 50% in buff inventories, it is claimed. In explanation, it is stated that interchangeable centers with variable arbor hole sizes permit the accommodation of all machines having different spindle diameters from just one standard stock of buffs, at a minimum inventory investment.

For those users having buffing and polishing equipment with the same sized spindles or arbors, this new type buff is available with permanent steel centers, at no extra cost.

The new buffs, it is stated, are made of sturdy, wear and tear resistant 86/93 count sheeting. Extra safety is designed into the buff construction around a heavy-gauge steel ring with hundreds of interlocking teeth which tightly grip and securely hold buff together.

Whirlwind buffs are available from stock in 12"-14"-15"-16"-18" diameters with interchangeable centers and 1¼" to 2" diameter arbor holes.

Cleaning Machine

Equipment Division, Magnus Chemical Co., Inc., Dept. MF, Garwood, N. J.

A new model has been added to the company's line of ball, roller and needle bearing washing machines — The Cabinet Ball Bearing Washing Machine, Model RT.

The new model is of the batch type with loading and unloading at the same location and consists of a cabinet, spray system, pumps, solution tank, rotating cones, filtering system, etc. The washing and rinsing operations are performed at the same time inside the cabinet using the same spray system. Specially designed cones complete with removable extension spindels are installed inside the cabinet.

When fully loaded the machine holds four bearings. The bearings are placed on the cones or on the cone extensions, (depending on the size of the bearings being processed).

By means of a company engineered rotating system, the inner races of the bearings rotate 360 degrees in one direction and then through 360 degrees in the opposite direction. The outer race of the bearings does not rotate as it is held in a fixed position by a self adjusting spring loaded holding device. All inner and outer surfaces of the bearings are uniformally and thoroughly cleaned with filtered cleaning solution through nozzles located above and below the bearings.

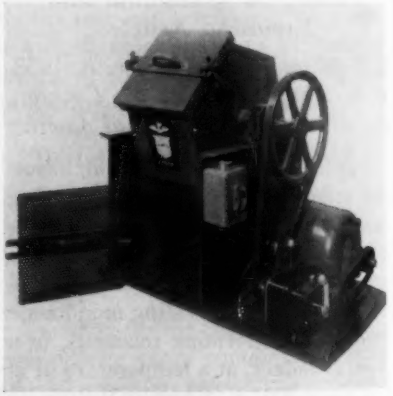
The machine has the capacity of 500 bearings per day.

Low-Cost Bench Model Tumbling Barrel

Lord Chemical Corp., Dept. MF, York, Pa.

The above company announces the new Lorco Model 100 bench tumbling barrel. Built entirely of heavy gauge steel, the barrel occupies only 14" x 24" of bench space. The 7½" x 12", plastic lined, steel drum rotates on double shafts mounted on heavy channels carried by self-aligning ball bearings. The 6" x 7" steel door, $\frac{3}{16}$" thick is Neoprene lined. A sturdy, perforated metal rinse door is included.

The barrel is powered by a ¼" h.p.



Century motor which operates on 110 volts at 60 cycles. Two different speed controls are offered, the Smith gear reducer or the Revco automatic transmission. The former, with three step pulleys, offers speeds of approximately 19, 35, and 58 r.p.m. The latter has an infinite speed variation in either direction from 0 to approximately 65 r.p.m.

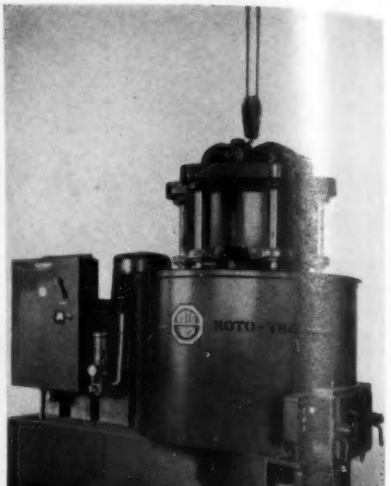
The price with either speed control is only $192.00, f.o.b., York, Pa.

Abrasive Finishing Machine

Roto-Finish Co., Dept. MF, 3600 Millham Road, Kalamazoo, Mich.

New engineering developments made possible by extensive experimental facilities, have extended the original barrel finishing process to include entirely new special fixtures, machinery and equipment. The new machines are a departure from the generally accepted conception of the tumbling or barrel finishing process. For instance, in the new Roto-Tron, fixtured parts are oscillated through an abrasive media that remains relatively static. This machine is best suited for finishing parts which are too large to be handled by the conventional cylinder type of machine. Parts must be rigidly fixtured during the finishing operation. For this reason the design of the parts should be such that they can adequately resist the rather heavy pressures created by the action of forcing the fixtured parts through the processing media.

The new machine has proven equally effective either for dry or wet processing, depending of course on the kind of part and the result to be produced. The principal difference in the wet and dry machine is in the tub for holding the abrasive media. The tub for wet media has a false bottom which allows accumulating refuse to drain away from the mass proper. It can be flushed from the machine without disturbing the main body of the abrasive media. Dry media can be



used in a similar machine using a deeper tub for holding the abrasive media than the tub used for the wet processing machine.

Cleaning Compounds

Turco Products, Inc., Dept. MF, 6135 South Central Ave., Los Angeles 1, Cal.

Two top-quality steam cleaning materials and a quick and effective concrete floor cleaning compound are now available in polyethylene-protected, heat sealed waterproof five pound packages.

The products offered in the new package are Super Steamfas, a heavy-duty steam cleaning compound, especially formulated to cope with the really tough steam cleaning jobs; Super Steameze, a light-to-medium-duty steam cleaning material for all-around all-purpose use; and Oilift, a nonhazardous, easy-to-use material for bleaching and removing grease and oil from concrete floors.

According to the manufacturer, the polyethylene-lined, heat-sealed small package will cut compound consumption up to twenty-five per cent. The five pound package is a measurable unit of the charge size, thereby eliminating spillage of material and costly overcharging of machines. The waterproof package eliminates wasteful caking of material, so often encountered with large drums.

The new five-pound packages are packed ten to a case for easier handling and storage. All packages and cases are color coded for quick and easy identification.

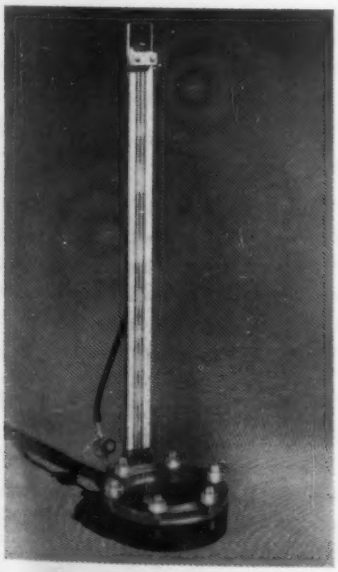
Stress Measuring Instrument

Joseph B. Kushner Electroplating School, Dept. MF, 115 Broad St., Stroudsburg, Pa.

The development of a new instrument for measuring stress in electroplated metals, chemically deposited metals and paint and lacquer films has just been announced. The instrument, called a Stresometer, measures accurately, easily and rapidly, the stresses produced by the shrinkage or expansion of the deposited films. It can readily measure stresses ranging from over 100,000 psi. in tension to 50,000 psi. in compression.

The instrument on which a U. S. patent is pending, is actuated by the deflection of a simple flat metal disc under the stress forces produced in the deposited layer. This deflection though quite small, is instantly magnified more than a thousand times by a unique hydraulic arrangement, so that a deflection in thousandths of an inch can be read in inches on the linear stress scale of the instrument. The method eliminates completely the difficult, tedious and time consuming procedures formerly required for making stress measurements, particularly on electroplated metals.

The instrument can be used directly in the plating tank for control purposes (measurement and control of stress and impurities and addition agents) or it can be used for research purposes in a separate tank. It can be used to correlate stress with various factors such as current density, pH, temperature, and chemical constitution, to mention just a few, of the many possibilities. The instrument is

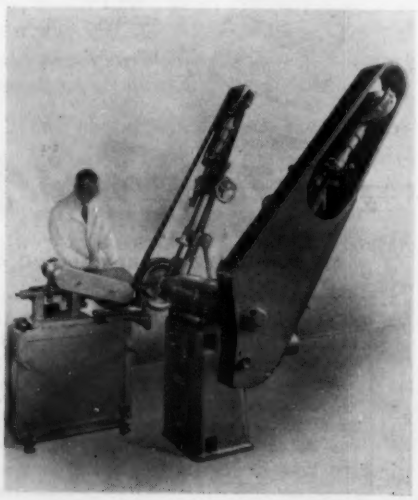


made in two models, one of high temperature Lucite for measurements on plated coatings and chemically deposited metals; the other of metal, for measurement of stress in paint, lacquer and plastic films.

Centerless Grinding and Polishing Attachment

Curtis Machine Corp., Dept. MF, Jamestown, N. Y.

A centerless grinding and polishing attachment which can be used permanently or intermittently with existing polishing lathes or backstand equipment has been announced. The machine, Model RSPG, is being made exclusively for Curtis by an affiliate company in Germany. Being simply a unit which can be used in conjunction with a polishing lathe or belt grinder,



it can be utilized for grinding and polishing with belts or set up wheels, or for polishing with buffs, in combination or in tandem.

The low-cost attachment can be easily moved from a belt grinder or buffing lathe for intermittent use or it can be permanently located for long production runs. The unit can be quickly adjusted to align with existing polishing and grinding equipment.

Barrel Finishing Machine

Almco Div., Queen Stove Works, Inc., Dept. MF, Albert Lea, Minn.

The new model DBO-1A barrel finishing machine is a new, compact

model that features less floor space, simplified operation, finger-tip control. Variable speeds are from 8 to 45 R.P.M. and the all-in-one control and drive unit is built-in panel mounted. Twin barrels are 8″ wide by 16″ across the flats. Self-contained screening drawer for loading, unloading, separating parts from media.

Water Saving and Proportioning Control

Industrial Sales Div., Hays Mfg. Co., Dept. MF, 816 West 12th St., Erie, Pa.

A new water line flow volume control designed to maintain one set flow rate regardless of variable inlet pressures is available, which will automatically compensate for surges in line pressure, and pressure drop. It is preset to deliver one constant rate anywhere between .2 g.p.m. and 14 g.p.m. and will maintain operating accuracy of 10% within the variable range of 15-150 p.s.i. The control is known as Mesurflo and is available in ¼″, ⅜″, and ¾″ pipe sizes.

Plastic Package Sprays on Peels Off

Manray Products, Inc., Dept. MF, 12400 Crossburn Ave., Cleveland 11, O.

Extensive research work has resulted in the development of a superior coating which is easy to apply, easy to remove and which can be furnished in a wide range of colors as well as water-clear. Peel-Kote possesses extremely high adhesion characteristics and at the same time will peel off

Now, modern Peel-kote packaging easily peels off when desired.

rapidly in continuous easy-to-handle strips. Its high solids content permits fast, heavy build-up of film for maximum protection of metal and easier strippability.

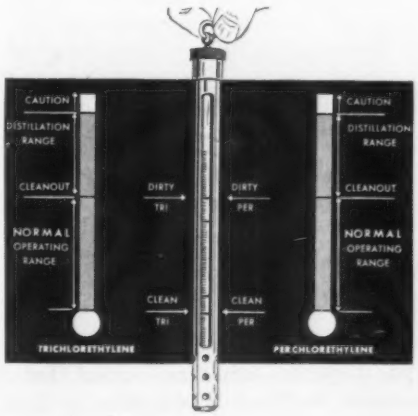
The coating is especially suitable for the packaging and protection of high polished or plated industrial parts and products. It has a high degree of elasticity, has high resistance to abrasion and, when dry, will not support combustion. It is normally sprayed, but special formulations can be supplied for dipping. It is immune to the attack of most corrosives and the manufacturer claims it can be stored indefinitely without any undesirable effects.

In addition to ease of application, enhanced appearance and protection of product, the coating can be left on during final installation of some products to give maximum protection to the surface right up to the time of actual end use.

Degreaser Cleanout Indicator

Randall Mfg. Co., Inc., Dept. MF, 801 Edgewater Rd., New York 59, N. Y.

The above firm announces its new vapor degreaser cleanout indicator, which is claimed to keep an accurate check on the condition of solvents in degreasers. Adequate maintenance and control are possible with the indicator,



as well as greater savings in machine "shut down" time; greater solvent recovery; and effective and rapid removal of soil.

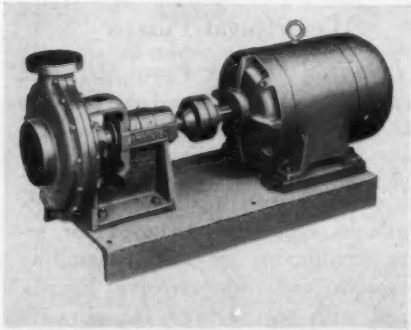
The indicator, available at $7.50, comes complete with a performance and control chart, plus cleaning instructions.

Vulcanized Rubber Lined Centrifugal Pumps

Industrial Filter & Pump Mfg. Co., Dept. MF, 5900 Ogden Ave., Chicago 50, Ill.

An improved line of vulcanized-rubber lined centrifugal pumps is now available, especially designed for severe, continuous service in handling corrosive and noncorrosive liquids. Lined with soft rubber for abrasive

slurries or hard rubber as specified, balanced rotating assembly mounted in ball bearings, corrosion-proof stuffing box to permit external liquid seal if required, easily removable packing gland nut and ample space for repacking stuffing box, simple adjustment of impeller clearance are some of the construction features.



These pumps are available in a range of sizes with capacities up to 240 gpm., operating heads of 240 feet and ¾ to 15 hp. They are furnished either with or without base, motor, and coupling.

Magnetic Amplified Control for Rectifiers

Crown Chem. & Engineering Co., Dept. MF, 4722 Worth St., Los Angeles 53, Calif.

The above firm announces a new type magnetic amplifier control for selenium rectifiers. Pictured is a 12-volt 6,000 ampere selenium rectifier. One of the striking features of this new type control is the response time. When the unit is operating at 12 volts and the load is increased from 600 amperes to 6,000 amperes instantaneously, the magnetic amplifier will adjust the voltage to its preset value of 12 volts within ½ second. Another feature is the compactness of both the power unit and the remote control. The power unit is only 48″ wide, 78″ high, 44½″ deep, and the remote control unit is 21½″ long, 11″ high and 3″ deep. The remote control houses the voltmeter, ammeter, start-stop buttons and voltage adjusting potentiometer. All other components are housed in the power unit.

Aluminum Cleaner

Northwest Chem. Co., Dept. MF, 9310 Roselawn, Detroit 4, Mich.

The development of Acid Solvent Emulsion Cleaner No. 1, a new chemical for completely removing soil from fabricated aluminum parts prior to finishing, has been announced recently.

The cleaner prepares the surface for any type of final finishing whether it be plating, painting, anodizing, zinc chromate priming and others. It is non-corrosive and will not harm the metal no matter what the bath temperature or how long the immersion time.

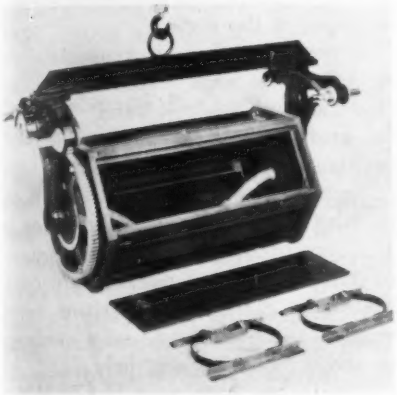
Easily rinsed, fast cleaning, and easily controlled, the cleaner is readily emulsifiable. It is economical to use since all that's necessary to control the mixture is the addition of water to replace evaporation and small cleaner additions to maintain efficiency. The solvent emulsion is non-toxic and safe to use. The company offers to process

sample parts to prove the excellent job done by the new product.

Plating Barrel

The Udylite Corporation, Dept. MF 1651 E. Grand Blvd., Detroit 11, Mich.

The development of a new plating barrel with a cylinder made of Tempron hard rubber has been announced recently. With this new material and specially designed construction, this new cylinder offers advantages heretofore impossible. It withstands, even under load, higher temperatures than have been possible to use with any thermoplastic material, such as Lucite or Plexiglass. The new cylinders can be used most effectively through the entire plating cycle. The material has better abrasion resistance and withstands stronger acids.



New design and construction, (Patents applied for), offer greater strength than even the one piece construction. The ingenious system of interlocking panels and ribs not only makes it stronger but also permits the easy individual replacement of component parts whenever necessary.

The manufacturer also offers a Teflon liner or membrane with very small perforations, smaller than can be obtained by conventional drilling methods. This liner can be installed in this new cylinder with only minor modifications.

Plastic Work Gloves

Edmont Mfg. Co., 1276 Walnut St., Coshocton, O.

A brand new line of industrial plastic work gloves has just been announced, called "Green Turtle" for long life and is competitively priced. Three styles are available — a palm coated knitwrist, a fully coated knitwrist and a fully coated 12″ gauntlet. All are made of full cut, strong fabric liners — coated with a specially compounded, dark green plastic. They are very flexible, have an excellent grip and the fully coated styles are guaranteed liquid proof. The modern coating has outstanding resistance to abrasion and will not chip, crack or peel.

Additional information may be obtained by contacting the manufacturer at the above address.

BUSINESS ITEMS

Norton and Diggin Appointed Company Officers by H-VW-M

Hanson-Van Winkle-Munning Co., Matawan, N. J., announces the appointment of *Robert M. Norton* as vice-president and *Myron B. Diggin* as assistant vice-president. Both will continue their responsibilities as sales manager and technical director, respectively.

Sales manager for the last four years, Norton has been with H-VW-M for 14 years. He joined the company as a salesman, became sales represen-

Robert M. Norton

tative in New York State in 1941 and four years later was appointed district manager of the state.

A year after that his managerial responsibilities were expanded to include upper New England. In 1948 he moved into the home office as assistant sales manager.

Norton was graduated from Dartmouth College with an A.B. degree in 1933, and took post graduate courses in chemistry at Rutgers University. Following graduation he spent seven years as a salesman and sales manager in the communications field.

Diggin has been with H-VW-M for the past 24 years, and was appointed technical director eight years ago. He joined the company as a chemist, and was appointed chief chemist in 1933. His work has resulted in a number of developments and patents, particularly in the deposition of cadmium, zinc and lead; in rack coatings; anode diaphragms, and regenerative plating systems. In his new assignment, Diggin is expected to devote more time to the specific development and use of H-VW-M electrochemical processes.

He was graduated from Wesleyan University with a B.S. in chemistry in 1926, and was awarded an A.M. degree from the same university two years later. He taught chemistry at Wesleyan, established a consulting chemical laboratory, and later joined the technical staff of a chemical manufacturer.

A lecturer and author of numerous technical articles, Diggin is a member of the *Electrochemical Society, American Chemical Society, American Ordnance Association, American Electroplaters' Society, American Society for Testing Materials, Institute of Metal*

Myron B. Diggin

Finishing, American Institute of Chemists, and Research Committee of the American Electroplaters' Society. In 1946 he was awarded the A.E.S. gold medal.

La Lande and Beale Named Vice-Presidents of Pennsalt

The Board of Directors of the *Pennsylvania Salt Mfg. Co.* has established and filled two new offices. *Dr. William Alfred La Land, Jr.* was elected vice-president and will continue as manager of research & development. *Edward F. Beale,* also named vice-president, is treasurer of the company.

Dr. La Lande, a graduate of the University of Pennsylvania, joined the company in 1944, and has been directing its research & development program at Wyndmoor (Pa.) since 1948. From 1927-37 he served as a member of the faculty of the University of Pennsylvania and, during the following year, did post-doctoral work in organic chemistry at the Swiss Federal Polytechnic Institute in Zurich. From 1938 to 1944 he was director of research & development for the Attapulgus Clay Co.

Mr. Beale attended the William Penn Charter School and is an alumnus of Princeton University. From 1937-40 he was associated with the National Lead Co., becoming treasurer and controller of its John T. Lewis & Bros. Co., subsidiary, in 1940. Following separation from the military service in 1946 he joined Pennsalt as assistant-to-the-treasurer and was named controller in 1948 and secretary and treasurer in 1951.

Coppage Joins Permutit

It has been announced by *The Permutit Company,* New York, N. Y.,

John S. Coppage

pioneer manufacturers of water conditioning equipment and ion exchange resins, that *John S. Coppage* has joined its sales department as manager of sales, Chemical Service Division.

Mr. Coppage will be responsible for directing field salesmen and engineers in the application and sale of Chemical Division products and services, under the direction of *E. M. Partridge*, manager. His efforts will be devoted toward extending the service facilities in the fields of boiler feed, air conditioning, and corrosion control.

Well equipped for his assignment, Mr. Coppage is a graduate of the University of Minnesota, with a degree in Chemical Engineering. For ten years, he was sales and service engineer for The Flox Co., distributors of Nalco chemicals and for five years was sales and merchandise manager of a division of the Minnesota Mining and Mfg. Co.

Lord Chemical Wins Award

H. .R Stiteley, president, receives the NAAN Award of Excellence for Lord Chemical Corp.'s Single Unit Advertisement or Promotion. W. B. Brandt, vice-president, looks on pleased as A. H. Burnham (left), account manager for The W. H. Long Co., Inc., makes the presentation.

For its Single-Unit Advertisement or Promotion which appeared in Metal Progress, Metal Finishing, Materials & Methods, Purchasing News, and Philadelphia Purchaser, *Lord Chemical Corp.*, York, Pa., has been awarded the Award of Excellence in the 1954 Creative Awards Competition of the National Advertising Agency Network.

The award certificates and confirming documents have been presented to *H. R. Stitely*, president, and *W. B. Brandt*, vice-president of Lord Chemical.

Diversey Promotions

W. E. Noyes, vice-president in charge of sales for *The Diversey Corporation*, Chicago, announced the promotions of five men to new key sales positions within the sales department.

R. J. Stell was named manager of new product development, a newly created position; *C. R. Reid was* promoted to assisted general sales manager; *E. M. Petrie* has been appointed manager of the technical service department; *M. J. Butler, Jr.* was named advertising — sales promotion manager; and *H. M. Pickles, Jr.* has been appointed assistant to Noyes.

First Employee Retires Under H-VW-M's New Retirement Plan

First employee to leave *Hanson-Van Winkle-Munning Co.* under the com-

pany's new retirement plan is *James J. Gormley* of Matawan, who retired after 42 years with the company.

Louis H. Hague, president of H-VW-M, formally presented Gormley

his first monthly retirement check. The presentation was made in the president's office.

He was employed in the company's tin can shop, where he spent most of his working hours during the past 34 years. When he joined the company in 1912, he fired boilers at first, and then worked in the anode foundry.

Mr. Gormley lives at 9 Clinton Street, is married to the former Katherine Keyes, and has three sons — James, Raymond and Thomas.

Under the company's new plan, the normal retirement age is 65. Provisions for earlier retirement after reaching 55 are also provided for employees who have 15 years of continuous service.

Enthone Appoints Distributor

Enthone, Inc., New Haven, Conn., announces the appointment of *Weaver Engineering and Supply Co., Inc., Grand* Prairie, Tex (Dallas) as stock point distributor for their complete line of chemicals for the metal finishing industry. Stocks of Enthone products will be maintained at the Grand Prairie location for shipment to concerns in Texas, Oklahoma, Arkansas and Louisiana.

James Weaver, president will continue to offer Enthonics service in this expanded area with the assistance, when necessary, of the Enthone technical service laboratory and engineers.

Austin F. Fletcher, Inc. Formed in Binghamton

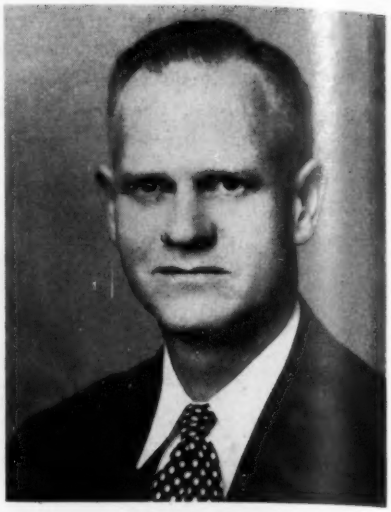
Austin F. Fletcher, Inc., a corporation under the laws of New York State, has been formed in Binghamton, N. Y. This organization will offer sales of chemicals, equipment and metal finishing processes to the metal finishing industry of upper New York State and northeastern Pennsylvania.

This corporation was organized by *Austin F. Fletcher*, formerly sales and service engineer for Enthone, Inc., New Haven, Conn., in this same area. He becomes president and general manager of the corporation which also includes *Warren Fletcher* as vice-president.

Mr. Fletcher's plans call for handling a complete line of products, processes, equipment and basic chemicals for the metal finishing industry. Most of the items will be stocked in Binghamton — including Enthone products. Service on Enthone products will be continued as in the past by Mr.

Austin F. Fletcher

New plant of Austin F. Fletcher, Inc.



Warren Fletcher

Fletcher and his assistants, supplemented where necessary by Enthone chemists and engineers.

Electric Equipment Company to Observe 20th Anniversary

The *Electric Equipment Co.* completed 20 years of service to industry on June 4, 1954, according to an announcement by *Irving S. Norry*, president.

During that period the firm has supplied a total of more than 5,000,000 horsepower of guaranteed rebuilt electric motors, generators and transformers to industries throughout the United States, Mr. Norry said. The units have ranged in size from less than 100 pounds to over 150 tons.

Mr. Norry observed the anniversary by moving up to chairman of the board, and he was succeeded as president by *Sidney Gilbert*. All employees were guests of the company at lunch on the anniversary date.

Grieve-Hendry Co. in Larger Quarters

Grieve-Hendry Co., Inc., manufacturers of laboratory and industrial ovens, are moving their factory to larger space at 1401-17 W. Carroll Ave., Chicago 7, Ill.

Expansion has been made necessary due to continued growth and the introduction of many new and larger models for industrial processing.

Stump Appointed National Sales Manager by Lord Chemical

Quentin S. Stump has been recently appointed national sales manager for *Lord Chemical Corp.*, York, Pa., manufacturers of chemical compounds,

Quentin S. Stump

tumbling barrels and media for all precision barrel finishing.

Mr. Stump began his sales career in 1937 as sales manager for Mrs. Smith's Pie Co. at their York branch. Two years in the U. S. Navy interrupted his job from 1943 to 1945. Afterward, he returned to Smith's as sales manager until 1948, when he left to become president of his own company, the Hill Electroplating Co., York, in charge of management and sales. During his stay with Hill, he spent two years studying metal finishing processes and development.

Mr. Stump joined Lord Chemical in 1952 as a sales engineer and, as a result of his excellent record of sales, was made national sales manager in March, 1954.

Minnesota Mining Promotes Armstrong

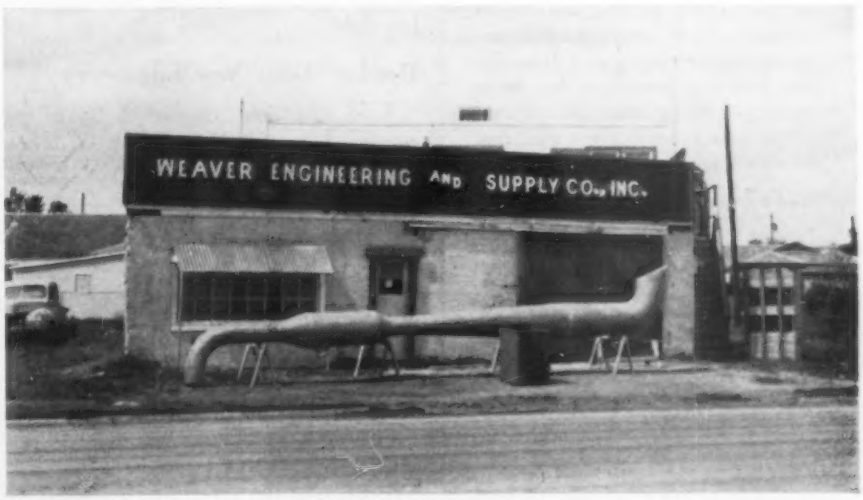
Promotion of *William H. Armstrong* to sales supervisor of Honite brand products was announced recently by *Minnesota Mining & Manufacturing Co.*

He will headquarter in St. Paul. Previously he was a salesman in Philadelphia, Pa., and New York.

Weaver Engineering Expands

Weaver Engineering and Supply Co., Inc., 718 West Main St., Grand Prairie, Tex. (Dallas), in a move to expand with industry in the Southwest, announces the purchase of an office and warehouse of 3,500 square-foot area at the above address.

As distributors for Enthone, Inc., R. C. Hull and Co., Formax and Munray Products Co., they will maintain complete stocks of the products of these organizations to better serve the



metal finishing industry in the Southwest.

In addition to distributing and warehousing these products, Weaver will also manufacture resinbonded Fiberglas tanks, duct work and hoods, will line tanks with plastic lining, and will design, manufacture and coat plating racks with plastisol rack coating.

Andrews Heads Metal Removal Co.'s Research & Development

Sidney Andrews

Sidney Andrews has been named vice-president in charge of research and development for the *Metal Removal Co.* of Chicago. The announcement was made by *Charles E. Davis*, company president. Mr. Andrews will be working on the firm's abrasive grinding wheels, discs, and mounted points.

Formerly, Mr. Andrews had been engaged in production and research with the Bay State Abrasive Products Co., Westboro, Mass. The many new products he has contributed to the abrasive industry has made him one of the foremost development men in his field.

Hooker Adds New Engineers

Two chemical engineers have recently been employed by *Hooker Electrochemical Co.*, Niagara Falls; *Dr. Alex Katona* and *Benjamin B. Halleck*.

Dr. Katona, formerly of Cleveland, Ohio, has joined the research and development department in the pilot plant group. He recently completed the requirements for his doctor's degree in chemical engineering at Case Institute of Technology, under a fellowship grant. From Case Institute Dr. Katona also obtained his bachelor of science and masters degrees in chemical engineering in 1949 and 1951 respectively. He was an assistant in the department of chemistry and chemical engineering there from 1949 to 1951. From 1943 to 1946 he served with the U. S. Army Engineers. The professional societies to which Dr. Katona belongs are the American Institute of Chemical Engineers, Alpha Chi Sigma and Sigma Xi.

Mr. Halleck, of Bethesda, Md., has been assigned to the process study group of Hooker's operation department. He was graduated from the University of Maryland in 1951 with the degree of bachelor of science in chemical engineering. Mr. Halleck was then employed for a time as an analyst by the Department of Agriculture in Maryland. After four years in the U. S. Navy, where he became a Lieutenant, (jg), Mr. Halleck came to Hooker. He is a member of the professional society, Alpha Chi Sigma.

Dow Opens Cincinnati Office

The Dow Chemical Co. announces the opening of a new field office in Cincinnati to serve customers in southern Ohio, southeastern Indiana and sections of Kentucky and West Virginia.

Donald Williams, vice-president and director of sales, said the office, located at 2330 Victory Pkwy., will be under direction of *Fielding H. Yost, Jr.*, manager of the Cleveland office. It will handle all Dow product categories, including industrial and fine chemicals, plastics, magnesium and agricultural chemicals.

This is the second field office to be opened by the company in the past 12 months, the first being located at Minneapolis. They are part of a general program to provide improved service for customers. In addition to the two field offices, Dow maintains twelve offices in major cities throughout the country.

Moehlenpah Engineering, Inc. Appointed Wagner Brothers Distributor

Moehlenpah Engineering, Inc., 1315 Vandeventer Ave., St. Louis 10, Mo. (main office) has been named as Midwestern distributor for the Wagner line of electroplating equipment and supplies, it was announced by *J. D. Tebben*, vice-president, *Wagner Brothers, Inc.*

Moehlenpah's eight field sales engi-

neers will cover a territory consisting of Southern Illinois, Missouri, Iowa, Eastern Kansas and Eastern Nebraska and is also represented by sales offices at 4450 Main St., Kansas City 11, Mo. and at 1308 33rd St., Des Moines, Ia.

Alert Supply Co. Given Western Distributorship by Wagner Brothers, Inc.

Recently appointed West Coast distributor for *Wagner Brothers, Inc.*, Detroit manufacturers of electroplating equipment and supplies, is *Alert Supply Co.*, 4755 East 49th St., Los Angeles 58, Cal., announced *J. D. Tebben*, vice-president of Wagner.

Alert Supply will also represent Wagner in Northern California, Washington and Oregon from their distribution outlets in San Francisco, Seattle and Portland. Wagner Brothers, Inc. presently have representatives in Chicago, Cincinnati, Cleveland, Indianapolis, New York, Philadelphia, Rochester (N.Y.) and St. Louis.

Lasalco Appoints Process Engineering Co.

Lasalco, Inc., of St. Louis, Mo., announces the appointment of the *Process Engineering Co.*, 4918 Jarvis Ave., Skokie, Ill., as their distributors in the Chicago area for Lasalco barrel platers, full and semi-automatic plating conveyors, burnishing barrels, driers, and other items manufactured by Lasalco.

Process Engineering has been actively serving through thoroughly experienced representatives, the electroplating needs of the graphic arts industries in this territory. They have done considerable work in both electroforming and applications of the nickel sulfamate solution and with various fluoborate baths.

Bart-Messing Corporation Opens New Plant

Completion of a new building that will provide an additional 12,000 square feet of manufacturing space for Sel-Rex selenium rectifiers, has been announced by *Morris M. Messing*, president of *Bart-Messing Corp.*, of Belleville, N. J.

The new building is the third structure erected by Bart-Messing and associated companies in the past 18 months, on a six and one-half acre tract on Manchester Place, Newark, N. J. With the new plant, the associated companies now operate seven plants in the Belleville-Newark area for the manufacture of plating equipment and production of specialized types of industrial precision plating.

The new one story structure, serviced by main lines of two major railroads, is ideally planned for expanded production. Manufacturing facilities are set up on an assembly line basis, and include the most modern equipment and testing devices.

The main offices of the company,

which handles a complete line of plating supplies and equipment, will be retained at the Belleville plant.

Metalwash Appointments

Metalwash Machinery Corp. of Elizabeth, N. J. has appointed two additional sales representatives for its industrial line of machinery.

Charles J. Auger, with headquarters in Detroit, will represent the company in the State of Michigan for washing, pickling, drying and degreasing machinery. Mr. Auger, a graduate of Princeton University has been associated with the Metalwash Degreaser Division, at the factory, for a number of years.

Charles J. Auger

Frank J. Johnson will represent the company in Metropolitan New York as well as in Northern New Jersey for some products. Mr. Johnson, a graduate of Georgia Institute of Technology, will handle degreasers and Uscolite (a plastic material used for corrosion resistant ventilation systems), in New Jersey; in New York he will handle the full line of industrial equipment for washing, pickling, drying and degreasing. Prior to this appointment Mr. Johnson was associated with the sales engineering department of the company at its Elizabeth. N. J. plant.

Frank J. Johnson

Enthone Changes Name of Product

Enthone, Inc., New Haven, Conn., announces a change in the name of

one of their standard products. "Enthol" is the new name of the product formerly sold as Enthone Compound 42. This product is an acidic solvent type cleaner utilized for many years by many concerns for the combined cleaning and phosphating of iron, steel, zinc and aluminum surfaces prior to application of organic finishing materials. The product is exceptionally easy to use either as a wipe-on, brush-on or spray-on type of material. It may also be applied in diluted form by simple immersion. No complicated precleaning or after treatments are required.

Chandeysson Electric Company Awards Service Pins

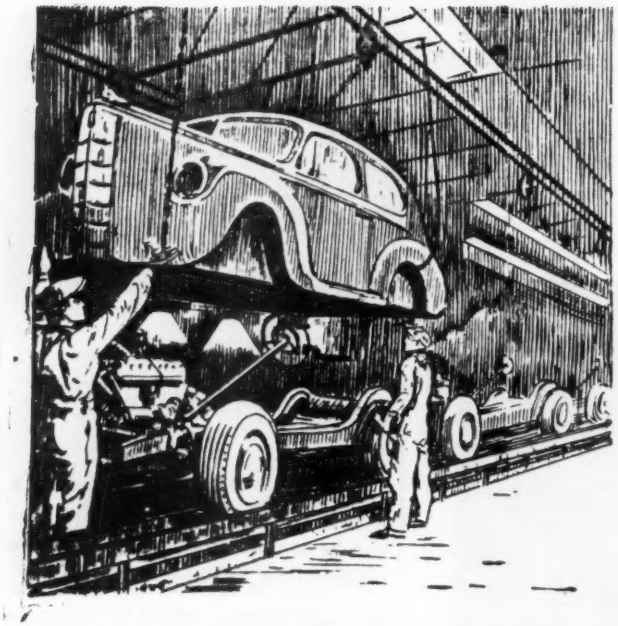
Left to right, standing — Mrs. Adele Chandeysson, Miss Dolores Bundschuh, Mr. James F. Carland, Mr. T. A. Leonhardt.

On June 2 at the Gatesworth Hotel in St. Louis, *Chandeysson Electric Co.* held a dinner dance for all employees of the company.

Following the dinner, service pins and certificates were awarded to all employees with more than five years of service. In all, 80 pins were awarded, of which 24 were for more than 20 years of service. Four of these have been with the company more than 30 years.

In addition, engraved gold watches were given to 15 employees with more than 25 years of service.

The awards were made by *James F. Carland*, executive vice-president of the company, who pointed out that the 15 men and women seated at the head table had a combined experience with the company totalling 350 years.



MOTOR CITY PLATING NEWS

ARco Names W. C. Enright as Sales Manager

Jointly announced by *Tim G. Meulenberg*, president, and *R. L. Redmond*, vice-president, at *Automotive Rubber Company, Inc.* headquarters in Detroit, was the appointment of *William C. "Bill" Enright* as sales manager.

A native Detroiter, Enright is a graduate of the University of Detroit, acquiring B.M.E. and L.L.B. degrees. He is also a member of the Michigan State Bar Association. Before joining the firm, he spent ten years as a metallurgical engineer with the Chrysler Corporation. Following that, he was made district sales engineer for Western Felt Works, a post he held for three years.

W. C. Enright

Coming to ARco in 1939, Enright became a member of the company at its inception and served as a sales engineer for the enxt six years. In recognition of his outstanding work, Enright was appointed head of equipment assuming responsibility for activities in the fabrication and rubber insulation of process equipment.

In his new position as sales manager, Enright's functions will consist of all phases of rubber products manufacture, materials compounding, fabrication, and lining services, involving company facilities in Detroit and Kalamazoo, Mich.

H-VW-M Expands Michigan Sales Force

Hanson-Van Winkle-Munning Co., manufacturer of plating and polishing equipment and supplies, has expanded its Michigan sales force. *C. M. Knights* was appointed special representative for the Detroit area, and *J. D. Kershaw* is the new Michigan district manager.

C. M. Knights

J. D. Kershaw

Knights will concentrate on direct selling with automotive accounts. A member of the American Electroplaters' Society, he has been with the firm for 25 years.

Kershaw joined the company in

1945, after spending four years with an automotive firm as a plating supervisor. Also a member of the A.E.S., he is a graduate of Illinois Institute of Technology, with a B.S. in chemistry.

Detroit Branch

A meeting of the Detroit Branch was held on May 7, 1954 at the Hotel Statler. Approximately 200 members and guests were present at this last meeting of the spring season. The first meeting of the fall season of 1954 will be held on September 10th, in the same location.

President *Joe Gurski* opened the meeting at 8:20 P.M. Eleven new applications for membership were presented before the meeting and all were voted into the Detroit Branch. The membership now exceeds 615 members for the Motor City's A.E.S. Branch. It was motioned and passed by the members that the Detroit Branch would incorporate. Mr. Gurski mentioned that the delegates to the National Convention would go uninstructed.

A report was read by *Glen Freidt, Jr.*, who prepared much ground work for information as to the possibilities of having the national convention in Detroit in 1959. It was learned that Detroit would have ample hotel facilities, as well as being conveniently situated near the new auditorium that will house the show if held in Detroit. These features will permit the Detroit Branch to make an attractive bid for the 1959 Convention.

After the showing of the Walt Disney film which depicted a colorful history of aviation prepared in Mr. Disney's characteristic way, *Fred Almstead*, educational chairman, presented the guest speaker of the evening, *Ray W. Redmond, production* engineer, Oldsmobile Division, General Motors Corp., whose topic "Prefinishing of Steel Prior to Electroplating" was well received by over 200 members present.

The talk centered around the use of abrasive belts, and particularly emphasized polishing the flat, prior to forming operations. Profilometer curves were projected showing scratch patterns and of back stand belts, from 100 grit through 320 grit both with aluminum oxide and silicon carbide grain. Purpose of this group of projections was to illustrate obtainable patterns.

The second series of projections illustrated polish line patterns from 80 micro inches down to 5 micro inches. These samples had been copper plated illustrating the smoothing out of deposited metals and with the gradual elimination of fragmented metal surfaces. This clearly demonstrated that, to produce a surface for the best results in plating, more attention must be paid to the condition and preparation of base metal surfaces.

The last series of projected slides were to some extent a duplicate of the previous ones. However, samples for these slides were taken at a 45° angle which emphasized the profilometer pattern to a greater degree than the same taken at right angles.

A lively question and answer period followed after which the meeting was adjourned at 10:45 P.M. Fellowship continued with the serving of beer and pretzels.

STAG DAY PICNIC

The Detroit Branch will hold its annual Stag Day Picnic on Saturday, July 31st, 1954, at the Glenn Oaks

Country Club on the outskirts of Detroit. The Stag Day includes the exclusive use of the golf club and course for the day, games with prizes, free beer and pretzels, buffet style dinner, entertainment and a door prize for everyone.

R. D. Dudley, United Chromium, Inc., is the general chairman for the occasion. His committee is as follows:

Advisory Committee — *W. L. Pinner* and *H. E. Head.*

Publicity Chairman — *J. C. Drinkwater.*

Ticket Chairman — *J. F. Seifen.*

Prize Chairman — *Manuel Ben.*

Parking — *C. Borlet.*

Athletic Chairman — *W. Wilson.*

Dinner — *D. Bigge.*

Finance — *C. C. Conley.*

Ex-Officio Members — *J. Gurski* and *L. Bourchert.*

Almost nine hundred members and guests attended last year's Stag Day, so orders should be in early for assurance of tickets. Tickets may be obtained from *John F. Siefen*, 5657 Lauderdale in Detroit.

John Drinkwater,
Publicity Chairman

Nickel Plating Capacity Expanded By Evans Products Company

The *Evans Products Company*, Plymouth, Mich., has purchased a fully automatic nickel plating unit to increase its plating capacity by more than 200 per cent. The plating department expansion was necessary because of the Evans company's recent acquisition of the Cycle Division of the *Colson Corporation*, Elyria, Ohio.

The new plating plant unit has a 9,000 amp. capacity, hydraulically operated conveyor with rising rack, a 1,350 gal. capacity nickel plating tank and 410 gal. chrome tank plus anodic and cold rinse tanks. The unit is 45 ft. long, eight ft. wide and eleven ft. high and can be operated by one man. When it is installed, it will give Evans a 35-40 minute cycle on plating.

Through the acquisition of the plating plant, Evans will be able to eliminate the use of copper plating under the chrome, and will make for a more efficient operation.

H-VW-M and J. C. Miller Co. Join Forces

Hanson-Van Winkle-Munning Co. of Matawan, N. J. and *J. C. Miller Co.* of Grand Rapids, Mich., jointly announced that they had entered into a formal agreement. The contract provides for the consolidation of the organizations and operations of both companies by the transfer of the physical assets, good will and organization of the Miller company to Hanson-Van Winkle-Munning.

J. C. Miller, founded in 1920, is a prominent manufacturer of buffing compositions for the metal finishing industry. It is the largest producer of tripoli compositions in this country. H-VW-M, founded in 1820, is one of the nation's leading manufacturers of electroplating and polishing equipment and supplies.

C. H. Walgren, president of J. C. Miller, will continue to direct operations of the Miller organization. Plans call for operations to continue under the same general management and policy as heretofore.

Arrangements have been made to include Mr. Walgren and *J. C. Miller*, chairman of the board of the Miller company, on the board of directors of H-VW-M.

Manufacturers' Literature

Purification of Chromic Acid Copper Stripping Solution

The Industrial Filter & Pump Mfg. Co., Dept. MF, 5900 Ogden Ave., Chicago 50, Ill.

A new bulletin on the ion-exchange system for purification of chromic acid copper stripping solution is now available. The operation of the system is described in detail and includes a tabulation of costs and savings.

Rectifier Bulletin

Wagner Brothers, Inc., Dept. MF, 400 Midland Ave., Detroit 3, Mich.

An illustrated eight-page bulletin, B20-54, describes different types of electroplating rectifiers, with capacities from 5 to 50,000 amperes, standard and special designs. Also covers regulators and controls for use in the plating industry.

Coated Abrasives

Minnesota Mining and Mfg. Co., Dept. MF, 900 Fauquier St., St. Paul 6, Minn.

A new booklet describing the use of coated abrasives for grinding and finishing nonferrous metals is now available.

It points out that using coated abrasive belts and discs for removing nibs, risers, burrs or flashings from nonferrous castings results in consistently better finishes, increased production and lower unit costs, with greater safety and less fatigue for the operator.

"Grinding and Finishing Nonferrous Metals with 3M Abrasives" shows before-and-after pictures of aluminum, brass, bronze, manganese bronze and magnesium products on which coated abrasive belts or discs were used. It also illustrates and describes specific grinding operations in nonferrous foundries throughout the country.

Rubber-Covered Factory Doors

American Hard Rubber Co., Dept. MF, 93 Worth St., New York 13, N. Y.

The new rubber-covered DuraDor, a heavy duty factory door designed to withstand the pounding, bumping wear of industrial lift trucks passing through is illustrated and described in new bulletin 52. The door is rigid, strong, light weight plywood, reinforced with sheet steel, and completely covered with a tough hide of rubber. The door is corrosion-resistant, excellent for chemical plants where corrosive fumes or splashing liquids are a problem. It eliminates need for expensive door-opening devices and bumpers, saves heat losses, and adds to worker comfort.

Coated Abrasives

Clover Mfg. Co., Dept. MF, Norwalk, Conn.

Originally issued in 1945, this handbook and digest of coated abrasive technology has been completely revised to keep pace with a fastmoving industry.

Written in simple, understandable language, with neither bias nor sales propaganda, this 36-page booklet contains a wealth of valuable technical information, much of it little known by most users and sellers of these essential tools of modern industry — a logical expansion of the author's

1941 Paper, "Coated Abrasives" — A Tool," originally presented before General Motors Institute at Flint, Mich. This new revised edition is sent free on request, without purchase obligation, to users and sellers of abrasives; to educational institutions and to libraries.

Mixed-Bed Demineralization

The Permutit Co., Dept. MF, 330 West 42nd St., New York 36, N. Y.

An informative 8-page bulletin, No. 3983, detailing the many advantages of mixed-bed demineralization has been made available.

Prepared from the talk, "Automatic Mixed-Bed Demineralizing at the "Albany Steam Plant," which was given before the recent meeting of The American Power Conference, the booklet recites the practical experiences and the economy of operation in utilizing the first fully automatic mixed-bed equipment to produce make-up water. In a table showing the comparison of equipment cost of an evaporator plant with a demineralizer, it proves that considerable capital expenditure is saved by use of the demineralizer.

The bulletin also gives a complete operating description of the process, shows installed equipment together with a schematic diagram of the demineralizer control arrangement. Summing up, it compares evaporator make-up costs to demineralized make-up costs, where again, demineralization saves approximately $6,000 annually.

Cleaning Guide

Wyandotte Chemicals Corp., Dept. MF, Wyandotte, Mich.

"Wyandotte Products for Cleaning Prior to Electroplating" details the features of the 11 products described in the folder, including the dust-free and foam-cutting abilities of the 3 electrocleaners. Two valuable charts are also included in this circular C-680.

One of the charts details a typical cycle for preparing metal for plating. The second chart is a products guide for cleaning before electroplating. In formation is contained in the charts and in the folder regarding acid treatment, electrocleaners and soak cleaners.

Copies of this circular may be secured from any of the company's 17 district sales offices, or from local sales and service supervisors who headquarter in 138 North American cities.

Industrial Waste Treatment

Graver Water Conditioning Co., Dept. MF, 216 W. 14th St., New York 11, N. Y.

Advantages inherent in the treatment of industrial waste waters and process liquors are described in Bulletin WC-116, Industrial Waste Treatment, just published. Schematic drawings, pictures, and a problem-solution-result type of explanation demonstrate how company equipment solves such problems as process and cooling water shortages, contamination of streams with plant effluents, and the loss of valuable heat and materials in discarded waters and process liquors.

Hard Chrome Plating Unit

Wagner Brothers, Inc., Dept. MF, 400 Midland Ave., Detroit 3, Mich.

An illustrated four-page folder describes a new package unit for hard chrome plating of production tools and parts. It tells how and why hard chrome is used in industry for great

savings, applications, advantages, uses. The folder, F30-54, explains the Morey process features of precise control of plate deposition, superior throwing power, maximum adhesion, density, ductility, and identical duplication.

Packaged Speed Variators

General Electric Co., Dpet. MF, Schenectady 5, N. Y.

A complete line of packaged speed variator drives from 1 to 200 horsepower is described in a new bulletin announced as available.

Designated as GEA-6127, the 20-page publication explains, with many illustrations, the operation and application of the basic speed variator and the many additional features which are available.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

New York Branch

The meeting on May 14th 1954 at the Hotel Statler, New York was called to order by President *A. Amatore* and a roll of officers was called and all were present.

President Amatore announced the presence of the following out of town members: *F. Eddy* of the Waterbury Branch. Mr. Eddy is a nominee for Third Vice-Pres. of the National Society. Also *L. Glassner* of Chicago. Mr. Glassner announced the date of the annual meeting of the National Federation of Metal Finishers which will be held in New York City July 13th, 1954.

There being no other business the meeting was then turned over to *Peter Veit* who, in turn, presented *G. Herrmann*, of the S. W. Farber Co. and Past Pres. of the New York Branch. Mr. Hermann's subject for the evening was "Plating on Lead Alloys" which was most interesting.

Lester Levinson,
Recording Secretary

Cincinnati Branch

This last meeting before the summer vacation period was enjoyed by 26 members and guests. President *Wm. Gordon* presided. Business meeting began at 7:35 P.M. with the reading of minutes of previous meeting. Letter from *P. Kovatis* indicating Boston had made a definite bid for 1958 Convention was incorporated as a correction to these minutes. President Gordon announced a change in the delegates and alternates to the National Convention: with final list as follows:

Delegates: *Robert D. Miller, L. A. Critchfield, Wm. Young.*

Alternates: *Wm. D. Gordon, Raymond A. Barry, Carl Truman.*

Ezra Blount began discussion of necessity of making a good effort on part of all delegates to National Convention toward lining up support for 1958 Convention at Cincinnati. After some comment a committee was appointed to promote plans for a 1958 Convention in Cincinnati, with the following members:

L. A. Critchfield, Chairman; *Ezra Blount, Chas. Wise, Will Loveless, Wm. Young, John Magly.*

President Gordon also asked all delegates and alternates to this year's National Convention to give full support to any plans formulated. *Wm. Young* was asked to represent the

Chapter at the Secretarial Luncheon, at this year's National Convention.

President Gordon appointed *Chas. R. Sorber* as a second representative with himself to the Technical and Scientific Societies Council; governing body of the Engineering Society. Gordon then opened discussion on a proposed revision to the Code of Council having to do with qualifications for membership in the Engineering Society. The proposed revision was made a part of these minutes. After some comment, it was decided that we would have little difficulty in qualifying under the new Revision. Critchfield moved and motion was carried that our representatives be authorized to vote for this proposed revision.

Details of the picnic to be held on June 12, at Devou Park were announced. After the business meeting, we enjoyed a timely and interesting movie, "Clean Waters."

President Gordon introduced the speaker for the evening, *Edward I. Peters*, of Process Engineering Co., Skokie, Ill., who gave a most interesting talk on the "Barrett Sulfamate Nickel Plating Process." The topic was well organized; covering the history of the process, its initiation in the printing field, its modern applications, bath composition, and characteristics. Some of the outstanding features claimed are:

1) Extreme low stress of deposit.
2) Exceeding hardness with ductility, and control of same.
3) Simplicity of control.
4) Stability of bath.

The talk was illustrated with slides. It was announced that details on the physical properties of the bath would be presented at the National Convention in July.

After the adjournment, the usual social hour was sponsored by Ruco, Inc. and Rack Processing Co.

L. J. Howald,
Secretary

Buffalo Branch

The Buffalo Branch wound up an eventful year with their final meeting held at the Hotel Markeen on May 7, 1954. The following officers were elected for the coming year:

President: *James Moneypenny.*
Vice-Pres.: *W. M. Fotheringham.*
2nd Vice-Pres.: *Dr. A. Janis.*
3rd Vice-Pres.: *Boris Joffe.*
Secretary: *Eric Sampson.*
Treasurer: *Roland Campbell.*
Sergeant-at-Arms: *Frank W. Rudolph.*
Librarian: *Robert Hofmann.*
Board of Managers: *Anthony Nigro, Leon Nowak, L. Davis.*
Convention Delegates: *James Moneypenny, W. M. Fotheringham, Bert Kirchoff.*
Convention Alternates: *L. Davis, Simon Bush, Eric Sampson.*

Picnic Committee Chairman *Joe Ruff* announced that August 14, 1954 has been designated as the date for the annual picnic. Members of the Toronto and Rochester Branches have already indicated their desire to share in the fun. Why should you be an exception? For reservations drop a note now to:

Joe Ruff, Picnic Chairman
1492 Berg Road,
Buffalo, New York

The various chairmen for the first Annual Educational Session Committee reported that plans are well under way to make this affair the educational and social event of the coming year. The date has been set for early October. Watch this magazine for further details.

H. A. Fudeman,
Publicity Director

Milwaukee Branch

The Milwaukee Branch on January 19, 1954 proudly announced their intention of nominating *Leslie Diveley* for the office of third vice-president of the Supreme Society. It is with regret that they now withdraw that announcement. Mr. Diveley has been informed by his physician that he cannot undertake the addition of further responsibilities owing to his physical condition. The nature of his illness is such that rest and relaxation will be required for some time and under these circumstances he could not fulfill the duties of the office of third vice-president.

Milwaukee Branch thanks all branches for their interest in the candidate and especially the many branches which had signified their support and approval of Mr. Diveley. The branch, of course, releases all branches and delegates who indicated their support and assure them their fine attitude is appreciated.

Vincent Mattacotti

Chicago Branch

About 60 Chicago Branch members turned out on Friday, May 14th, to hear *Dr. F. A. Lowenheim* of the Metal and Thermit Corp. speak on the deposition of tin alloys. As is customary at Chicago Branch meetings, the Educational Session was preceded by the business meeting and dinner.

At the business meeting, the group voted to contribute $150 to the John Crerar Library for the purchase of publications in the field of electroplating. The group also discussed the coming convention in New York. The possibility of a Chicago Branch group going down to New York as a group, either by special plane or private car, was discussed. In addition, the branch exhibits committee for the convention was appointed. After dinner, the group adjourned to the auditorium.

Dr. Lowenheim pointed that, generally speaking, "Mr. Electroplater" will be faced more and more with the problem of alloy deposition because alloys, as a general class, have more desirable properties than the pure metals of which they are composed. While alloy baths are slightly more complex and controls are more difficult, Dr. Lowenheim feels that, in many cases, the properties of the alloy deposit are sufficiently desirable to make the additional effort worthwhile.

He discussed the following tin alloys: lead-tin, copper-tin, tin-zinc and tin-nickel and gave baths for and outlined the principal variables and their control for each of the alloys. In addition, Dr. Lowenheim exhibited sample parts plated in the various baths which he had described. Group interest in the talk was indicated by the length of the discussion period and the penetrating questions asked.

After the talk and discussion period, a film describing automatic plating machines and their construction furnished by The Udylite Corp. was shown. The film was both interesting and instructive, showing the development of plating machines from drawing board to job.

The Chicago Branch would like to extend a cordial welcome to the following new members: *C. W. Jordan, Jr.*, Illinois Tool Works; *Robert G. Beaman*, Dearborn Chemical Co.; *Milton C. Johnson* and *Emerich Bechtold*, Illinois Tool Works. The branch hopes that the new members will avail themselves of all the Branch facilities and activities.

Jerome Kuderna,
Publicity Chairman

Grand Rapids Branch

The Grand Rapids Branch had an excellent turnout for its last meeting of the current season. Ninety-six members were present to enjoy a fine social evening at the University Club of Grand Rapids.

The evening began with a cocktail hour before a dinner of steak and shrimp. Afterwards the fellows were entertained by the Swanson Boys, Ronald, Russel, and Glendon who, with electric guitars, bass viol, and harmonious voices, put on a fine performance.

The meeting was then called to order by President *Carl Green*, who again thanked the retiring officers for their splendid work during the past year.

Two applicants were accepted as new members: *Chester Lomasiewicz* and *William Mooney* of Furniture City Plating Co.

Librarian *Tom Henner* opened the discussion session by introducing the following board of experts:

Charles Berry — Maas & Waldstein Co.

Charles Borlet — McGean Chemical Co.

John Hart — Hanson-Van Winkle-Munning Co.

C. W. Ostrander — Allied Research Products, Inc.

Robert Racine — Wyandotte Chemical Co.

One question fired at the experts was whether they knew of a cyanide nickel plating bath. There was no definite answer given to this question.

Mr. Ostrander next discussed the merits of chromate versus phosphate coatings as a paint base. He thought the phosphate coatings probably produce the best paint base. Chromate coatings give better corrosion resistance and are a good base for paint also. Phosphate coatings in themselves have little value for corrosion protection unless they are oiled or painted. Mr. Ostrander stated that his company has a drop test solution for checking the chromate film thickness on aluminum.

Maurice Caldwell asked if anyone knew of a commercial chromium bath that was about 33% efficient. No one, including *Jack Hanney* of United Chromium, Inc., knew of such a bath.

Next, the group discussed diaphragming in nickel baths.

The subject of cast versus rolled carbon nickel anodes was also discussed. The consensus was that they could be used interchangeably as there wasn't too much differance in performance in our modern chloride baths.

After the attentive "Round Table Discussion" the members were the guests of *Jack "Dusty" Rhoades* of Northwest Chemical Co., whose graciousness capped a very fine evening.

Kenneth Hampel
Publicity Chairman

Louisville Branch

The regular monthly meeting of the Louisville Branch was held Thursday, April 15, 1954, at Korfhages Restaurant, 1482 Preston St., Louisville, with a dinner served at 6:30 P.M. President *P. H. Pate* opened the business and open meeting at 8:00 P.M. with 28 members and guests present.

William B. Drake gave a report of the Tri-State Regional Meeting indicating that the meeting had a very good attendance and fine entertainment. The Regional Meeting to be held in 1955 will be held in Columbus, Ohio.

The Technical Sessions Chairman, *Stanley J. Beyer*, reported that *Dr. H. L. Kellner*, of the Lea Mfg. Co., Waterbury, Conn., will be the May speaker and the subject will be "Polishing of Metals." Also a General Electric Company movie entitled "Sight Seeing at Home" will be shown.

New members elected were *H. M. Switzer*, Silver Hills, New Albany, Ind. and *Nathan C. McCune*, 2327 Manchester Road, Louisville, Ky.

The newly elected officers for the Louisville Branch A.E.S. for the 1954 to 1955 fiscal year are as follows:

President — *John W. Scholl.*

First V.-P. — *William W. Francis.*

Second V.-P. — *Kenneth C. Reifsteck.*

Secretary & Treasurer — *Joseph G. Sterling.*

Librarian — *Stanley J. Beyer.*

Sargeant-at-arms — *John Kehrer.*

Board of Managers — *Arthur A. Oertel, P. H. Pate, Albert S. Engle.*

Delegates and alternate delegates elected to the National Convention to be held in New York City, New York, from July 12 to 15 inclusive are as follows:

Delegates — *Arthur A. Oertel, Stanley J. Beyer, Albert Steidle.*

Alternate Delegates — *J. G. Sterling, Kenneth C. Reifsteck, Wm. W. Francis.*

Mr. Pate turned the meeting over to Educational Chairman Beyer. After a brief talk, Beyer introduced *Ed Bruck*, president of Platers Supply Co., Indianapolis, Ind., as the speaker of the evening.

Mr. Bruck in his talk on the subject of relative merits of motor generators and rectifiers as a source of power for electroplating gave some very interesting information on the use of electrical power in small shops versus big plants including the good and bad points of each. Slides were shown and narrated by Mr. Bruck. Considerable discussion followed and Mr. Bruck was given a rising vote of thanks for a very interesting talk.

Refreshments were served — courtesy of the Platers Supply Co., Indianapolis, Ind. and the meeting adjourned at 10:00 P.M.

J. G. Sterling,
Secretary-Treasurer

Jackson-Lansing Branch

The May meeting of the Jackson-Lansing Branch was held Tuesday 5/11 at the Meadow Lark Inn, in Jackson, Mich., and the largest attending group of the season was present. After an unusually fine steak dinner, enjoyed by all, the group settled down to the business of the evening.

Dr. R. B. Saltonstall of the Udylite Corp. was the speaker of the evening. Dr. Saltonstall had recently returned from a trip to England, where he attended meetings of the international groups interested in electroplating. A very interesting talk held the interest of the group in which descriptions of English plating practices were given and methods of talks at conventions were presented.

A short description of bright plating developments starting with the advent of chromium plating in the mid-twenties with the numerous advantages and difficulties encountered made those present realize that a great deal of research work remains to be done. Many of the various phases of bright plating in relationship to the central problems were briefly discussed.

Dr. Saltonstall ended his talk with a few personal stories covering experi-

ence both in England and in Paris, making those present feel that such a trip and experience should be in order for all.

The branch again wishes to extend their thanks and appreciation to the friends from Udylite for the courtesies extended.

R. W. Boos,
Publicity

Los Angeles Branch

Los Angeles delegates to the Supreme Society Convention in New York in July were commissioned by unanimous vote of the membership at the A.E.S. branch meeting on May 12 to file a bid to have the next available convention of the *American Electroplaters' Society* held in Los Angeles.

The proposal, submitted by President *G. Stuart Krentel* following premeeting discussion by the executive board, elicited the hearty approval of all members. Various individuals pointed out that the 1950 convention, which had been assigned to Los Angeles, was transferred elsewhere due to the gravity of the Korean situation, and that Los Angeles was now again considered entitled to the honor of hosting a national convention. Delegates *Jack Bealle, Earl Arnold* and *William Horrigan* were instructed to present the invitation to hold the convention on the West Coast in 1958, unless a change in committments for 1955, 1956 and 1957 make an earlier date possible.

Eighty-five members and guests were present at the May 12 meeting to hear a talk on "Solvent Type Cleaners in Plating" by *Alexander G. Worman*, Southern California district manager for Solventol Chemical Products, Inc., of Detroit, Mich.

In discussing the application of multi-phase cleaners to the cleaning of metals prior to electroplating, Mr. Worman developed his subject along the following four lines: (1) What is a multi-phase cleaner; (a) How does it function?; (3) How does it differ from the various older, more conventional types of cleaners? (4) How is it applied to cleaning prior to plating?

Multi-phase cleaning, Mr. Worman explained, represents a relatively new and radically different development in the field of metal cleaning and constitutes the simultaneous application to the surface being cleaned of both an aqueous and a separate solvent system.

"As a result of the unique chemical and physical behavior of multi-phase cleaning systems," the speaker declared, "results are attained which cannot be achieved by the application of the more conventional types of cleaners." Mr. Worman emphasized that the multi-phase system is not equivalent to the use of separate aqueous and solvent cleaners in successive or alternating operations.

Eight new members were initiated into Los Angeles Branch at the May 12 meeting. These *W. C. Thompson, Edward Calderon, Kenneth Johnson, Sam Ramirez, Wilkie King, Roy Osborne, Tony Rojas* and *Lester Daniels*. Applications for membership were received from *Richard Hampton, Everett Wooley, Edward Bustamente* and *Richard Erickson*.

Earl W. Arnold, membership chairman, announced the details of a new membership drive to be held on a monthly basis-between May, 1954, the close of the fiscal year in April, 1955. Gift merchandise certificates will be awarded each month to the member sponsoring the largest number of accepted applications, in addition to

which a $50 certificate will be awarded at the end of the year to the member who has sponsored the largest total number of accepted applicants.

Larry O'Neill was appointed general chairman of the Branch's annual educational session to be held in March, 1955. *Tony Stabile*, research committee chairman, announced that *Howard Woodward's* California Rack Co. was the latest to join the ranks of sustaining members, bringing the Branch's total to fourteen.

News from California

By Fred A. Herr

Federated Metals Division of American Smelting & Refining Co. has plans underway for installation in its Los Angeles plant at 4010 East 15th St. of equipment for the manufacture of cast copper anodes in chilled form. Some 150 to 200 cavity molds, a pickling setup and auxiliary facilities will be installed for handling a production of 5,000 to 10,000 pounds of anodes per month, in sizes from one inch thick to lengths as required by trade. A section of the firm's existing west coast warehouse is being converted into an anode production department. *James M. Sowell* is manager of Federated's Los Angeles plating and electrochemical division.

Charles M. Petrie, vice-president of Pacific Tank & Industrial Coating Co. of Los Angeles has advised METAL FINISHING that his firm is branching out into the field of rack coating manufacture. A new department, he reported, is being installed in the company's plant at 3457 East 15th St., to supply the West Coast plating industry with rack coatings. The firm has been active for years in the field of tank fabrication, coatings for pipe and tanks, and plastics.

Los Angeles Branch of the *American Electroplaters' Society* boasts the unique honor of having one of its present members elected as the first president of the newly chartered Seattle, Wash., A.E.S. Branch. *Forster "Brad" Bradford*, now operating Industrial Plating Works, Inc., in Seattle, reported to Los Angeles friends during a visit to Southern California with Mrs. Bradford, that he had been chosen to head the new branch in May. He attended the June 9 meeting in Los Angeles and made arrangements to have his membership transferred to Seattle. He visited various plating shops during his Los Angeles stay, including those at Hallenscheid-McDonald Co. and Virtue Bros., in Los Angeles, and planned to inspect the electrolytic tinning setup at Kaiser Steel Corp. in Fontana, Cal.

Ernest Roehl, who has served in the firm in various technical capacities during the past two years, was recently appointed advertising and sales manager for Baron Industries, Los Angeles. The company designs and manufactures degreasers and solvents for the metal and organic finishing industries. *William Hamilton*, *Frank McQaurrie* and *John Hogan* are associated in the operation of the firm.

Powder Melting Corporation has been organized in North Hollywood, Cal., and in mid-June was ready to begin production in a plant at 6850 North Vineland Ave. The firm plans to develop new techniques for applying powdered metal to steel parts for greater life of the parts under conditions of severe abrasion, high temperature and corrosive situations.

Officers are *Robert E. Jones*, president, who also heads the Superweld Corp. of Los Angeles; *A. T. Cape*, vice-president, formerly with Timken Steel & Tube Co. and Carnegie Steel

Corp.; *Francis A. Gudget*, treasurer, formerly vice-president of Arlington Co.; and *M. H. Haas*, secretary, who is also a vice-president of the Superweld Corp.

Under an arrangement concluded in May, Leach Relay Co. of Los Angeles will serve as exclusive distributor in the eleven western states for selenium rectifiers produced by Fansteel Metallurgical Corp. of North Chicago, Ill. The sales arrangement calls for Leach Relay to cover Washington, Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Washington, Oregon and Utah. Fansteel sales engineers will continue to provide technical service in Los Angeles and San Francisco.

Cratex Manufacturing Co. of San Francisco announces the appointment of *Edward R. Bate* as sales manager to direct the national sales promotion for the firm's line of rubberized abrasive, burring and polishing products.

The Farr Company of Los Angeles, manufacturers of air filters and air filtration equipment, has named *Harold M. Robson* as central division sales manager, with headquarters in Chicago, Ill.

The first Western Plant Maintenance Show is scheduled to be held at Pan Pacific Auditorium, Los Angeles, July 13 and 15. Equipment and facilities spotlighting western plant maintenance problems in a score of industries are to be exhibited in the auditorium.

Solutions to maintenance problems peculiar to western states' industrial operation were to be emphasized in a concurrent two-day session of technical talks in conference rooms adjacent to the display area of the Pan Pacific Auditorium.

Sectional group discussions were scheduled on such topics as inspection procedures and frequencies; maintenance in aircraft, eelctrical equipment and metal working industries; maintenance operation in small plants; lubrication and its influence on preventive maintenance.

Speakers were to include *Maurice Olchoff*, plant engineer, Solar Aircraft Co., San Diego; *B. L. Peak*, superintendent, Sterling Electric Motor Co., Los Angeles; *C. M. Vigil*, general maintenance foreman, Douglas Aircraft Co., El Segundo; *Don L. Newton*, works manager, Kwikset Locks Co., Anaheim; and *Arthur Zobell*, plant engineering supervisor, North American Aviation, Inc., Los Angeles.

J. P. Ravelle, district manager of the J. P. Guthrie Co., Los Angeles, has announced that arrangements have been completed for the company to distribute on the west coast a new instant acting inhibitor produced by

the Nox-Rust Chemical Corp. The new inhibitor is said to provide effective protection in the lag time between packaging and vapor protection and to achieve control in seconds.

Waltz Furnace Co. of Cincinnati, Ohio, manufacturers of a variety of industrial furnaces for metal processing, enameling, flattening, tempering, drawing, carburizing and annealing, has appointed *Charles J. Paumier* as West Coast representative, with headquarters at 908 S. Atlantic Blvd., Los Angeles.

A. Edward Zezula, formerly associated with Wright Aeronautical Corp., Cincinnati, O., and Air Research Mfg. Co., Los Angeles, recently opened offices to function as a counsellor on metallurgical engineering problems at 1225 E. 63rd St., Los Angeles. He plans to offer advisory services on applications of materials to production of precision machinery, and is also equipped for analytical and testing services to manufacturers, foundries and heat treating firms.

Pictured here are the modern, new facilities of the San Francisco Branch of the Crown Chemical & Engineering Co. of Los Angeles, which recently passed the first anniversary of its operations in the San Francisco-Oakland area.

The San Francisco Branch occupies 5,000 square feet of area in a one and two-story building at 1 Dorman St., which includes office, warehouse and distribution facilities.

John R. Pattenger, who has been active in the plating industry in San Francisco for twenty years (past-president of San Francisco A.E.S. Branch), is Crown's Bay District manager. He reports the addition to the Crown sales staff of *David Patterson*, formerly a chemist with Schlage Lock Co.

The main office of the company are at 4722 Worth St., Los Angeles, where facilities are available for the manufacture of plating chemicals and supplies. The firm's rectifier division is located at 345 Kansas St., El Segundo, Cal., where the manufacture of selenium rectifiers is centered.